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APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

PTEMBER, 1949

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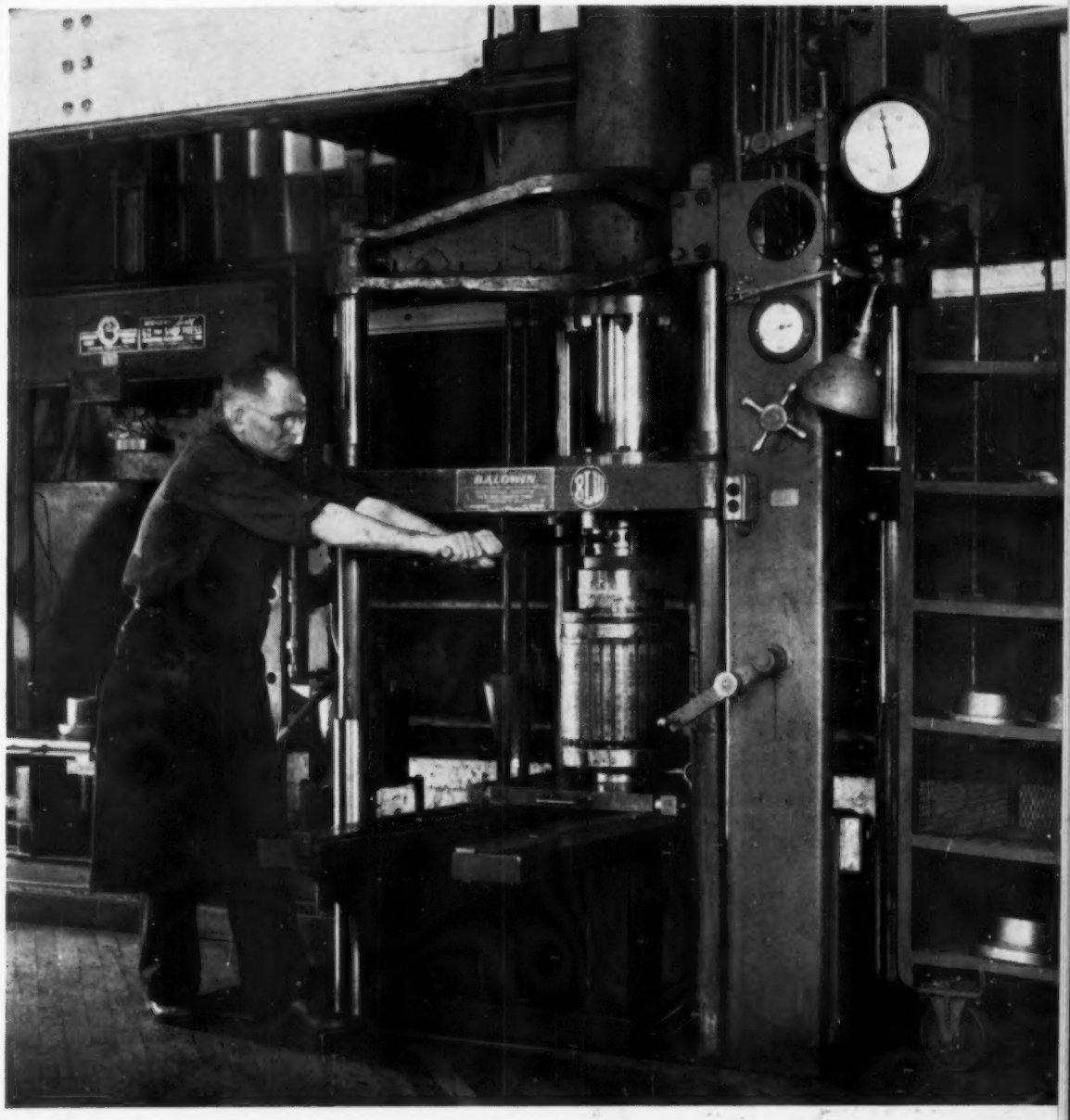

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CONTROL OF HYDRAULIC FLUIDS IN INDUSTRIAL APPLICATIONS— PAGE 7
QUALIFICATION TESTING OF FLUID CONTROL VALVES FOR AIRCRAFT SYSTEMS, PAGE 20

MEET THE "PL"* TWINS

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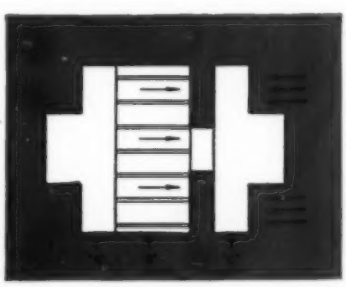

The schematic illustration at right shows the three principal parts of a gear-type hydraulic pump. They are the bearings ("A" played by "Fixed" and "C" played by "Floats") and the gear ("B"). Bearing "A" is fixed. Bearing "C" floats. By means of the "Pressure Loading" principle, pressure from the discharge of the pump is transmitted through a "Pressure Loading" passage and is exerted against the rear of the "floating" bearing. This force is counter-balanced by pressure developed within the gear cavity so that the thrust of the bearing against the gears is just enough to accomplish its purpose.

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SEPTEMBER, 1949

Vol. 2 No. 8

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FRONT COVER: An operator is turning the commutator nut on an armature shaft being held by a 40-ton load on a 75-ton hydraulic press. Note special large-dial high pressure gauge, controls and smaller air press at the left.

Photo courtesy, The Baldwin Locomotive Works

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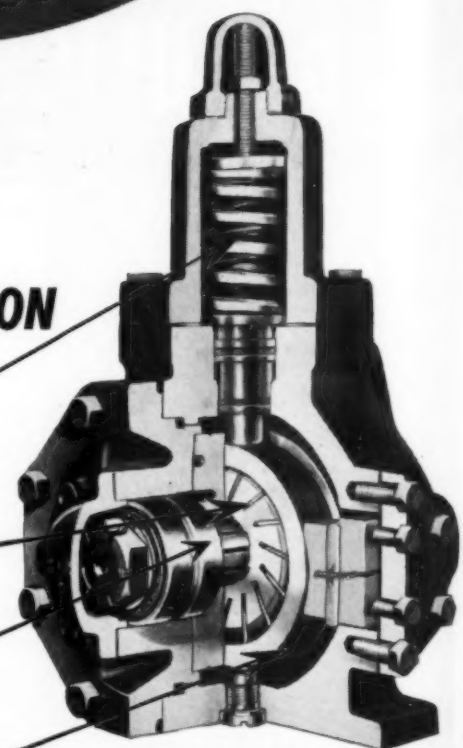

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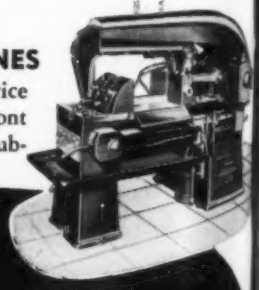

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STANDARD FOR QUALITY AND PRECISION

CONTROL OF HYDRAULIC FLUIDS IN INDUSTRIAL APPLICATIONS

By R. F. McKIBBEN
National Cash Register Co.

A PROGRAM FOR THE CONTROL OF hydraulic fluids in industrial machine tools has been in progress in our company for six years. It has proven to be of great help in maintaining operation of the equipment without serious interruption. Although it has required an appreciable amount of effort to carry out the program, its cost is believed to be small in comparison with the savings realized.

Although plans for a program of hydraulic fluid control had been made some time prior to the initiation of this program, a breakdown of a critical machine during the pressure of war production brought the plans into actuality.

The program as set up ties in closely with the general lubrication program in this plant. As now in effect, it is largely the result of our own research and experience. A "Lubrication Record Card", Figure 1, is placed on each machine, hydraulic and otherwise. The "Lubrication Record Card" specifies the part to be lubricated, the lubricant to be used, the stock number of the lubricant and the time for change

Screwmaking #2 DEPT. Bldg. 14 MACHINE INVENTORY NO. 10915

LUBRICATION RECORD Floor 4-16D DATE 12-3-43

Thompson Type F Grinder

Lubricate	Lubricant	Page No.	Change Period
Top Bearing and Elevating Screw	Ex. Hy. Lub. Oil	8571	Daily
Wheel Slide	Ex. Hy. Lub. Oil	8571	Keep Filled
Spindle	Ex. Lt. Lub. Oil	8702	Twice Daily
1-Hydraulic System	Ex. Lt. Lub. Oil	8702	*Indefinite
*To be checked periodically.			

Frequency of lubrication is based upon an 8-hour day. Longer daily operation requires more frequent lubrication. Record dates of lubricant changes indicated by numbered entries.

Dates							
2-11-44	4-10-44	11-17-44	3-2-45	6-18-45	1-3-46	6-12-46	1-11-47
1							
7-7-47	1-15-48	10-26-48	1-12-49				

Fig. 1. A Lubrication Record Card for a typical hydraulic production machine.

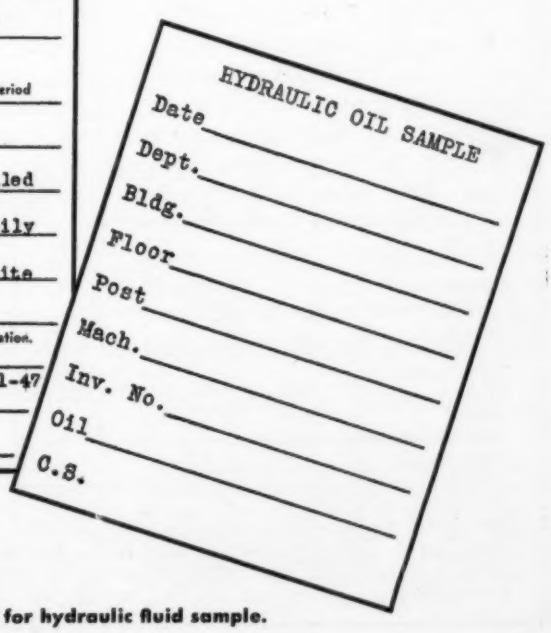


Fig. 2. Label for hydraulic fluid sample.

A program for the control of hydraulic fluids, based on the periodic analysis of the fluids outlined. This program, in operation for six years, has provided a means of insuring a high percentage of productive time with hydraulic equipment.

or re-application of the lubricant. For lubricant reservoirs which require periodic changes, space is provided at the bottom of the card to indicate the date of last change or inspection. In the case of hydraulic systems, the change period indicated as "indefinite" with a footnote calling attention to the fact that a periodic inspection is made.

All hydraulic machines, with exceptions to be noted later, are inspected at six months intervals, in January and July. In addition, certain machines, for reasons also to be given later, are also inspected in April and October, i.e., every three months.

The inspection is made by a member of the General Machine (Repair) Department. The inspection consists of an observation of the machine and its operating characteristics. In this manner, the General Machine Department is made aware of any unsatisfactory conditions which could lead to severe damage, and can immediately take steps to correct these conditions. This inspection also includes taking a sample of the hydraulic fluid. The sample is taken in an eight ounce bottle with a pump and a suction tube. The latter has its end stopped, but has an opening made one-fourth inch back from the end. A sample taken with the stopped end reaching the bottom of the reservoir does not, therefore, draw up foreign matter from the bottom, matter which is unlikely to be circulated with the hydraulic fluid.

All the samples taken by this procedure are labeled, indicating the machine from which the sample is taken, its inventory number, location, capacity of the reservoir and the stock number of the oil used. Figure 2 is a reproduction of this label. The samples are then forwarded to the Materials Laboratory where they are analyzed and the viscosity, acid number and appearance of each determined. The analyses are then forwarded to the Lubrication Laboratory which determines whether each fluid is satisfactory or unsatisfactory and issues a recommendations accordingly. These recommendations are made up with all of the satisfactory machines listed together, and all of the unsatisfactory ones listed in another group. All of the information required for changing the unsatisfactory oils is furnished with the recommendation, including the machine name, inventory number, location, capacity and the stock number of the oil required.

These recommendations are promptly forwarded to the General Machine Department which proceeds to change the oil in those machines where the analysis has shown it to be unsatisfactory.

The Lubrication Laboratory records the analysis of the oil from each machine in a Hydraulic Oil Record Sheet which becomes a continuous history of the machine. The Hydraulic Oil Record Sheet, Figure 3, was originally designed for a trial study and so provides space for recording much more data than is taken in routine work.

From this "case history", built up for each machine, the period for inspection is determined. When the program was initiated, all machines were inspected monthly. Within a few months this period was found to be unnecessary on most machines, and the time between inspections was lengthened to three months. Later, as more background was obtained, many of the machines had their inspection period extended to six months, which is the longest time allowed between inspections on any major equipment. However, on the other hand, there were a number of machines that required changing every few months, due primarily to leakage or to contamination. Since in most cases these machines had comparatively small reservoirs, the cost of taking the sample and analyzing it was more than the cost of the oil required for replacement. Accordingly, on the recommendation

Fig. 3. The Hydraulic Oil Record Sheet is a "case history" from which a program to protect the production efficiency of a grinder can be planned.

Inventory No. 10915

HYDRAULIC OIL RECORD SHEET

Department Screwmaking #2 Building 14 Floor 4 Post 16D

Machine Thompson Type F Grinder

Capacity of Hydraulic System 30 Gallons

Oil in Use 8702 Ex. Lt. Lub. Oil

Inspection Period 6 months

Date — Month / Day / Year	2 / 11 / 44	4 / 10 / 44	11 / 17 / 44	3 / 2 / 45	6 / 18 / 45	1 / 3 / 46	4 / 15 / 46	6 / 12 / 46	1 / 11 / 47	7 / 7 / 47	1 / 15 / 48	10 / 26 / 48	1 / 18 / 49	
Room Temp. F														
Oil Temp. F														
Viscosity @ 100 F SUS	153.8	154.6	153.8	158.1	151.5	158	157	148	162	160	154	270.9		
Neutralization No.	.083	.056	.087	.056		.02	.081	.053	.03	.025	.099	.013		
Emulsion														
Saponification No.														
Additions														
Color	0 clear sm.amt of dirt	0 clear OK	0 clear OK	0 clear sm.amtof dirt	0 clear OK	OK clear of dirt	0 std.	0 std.	clear sed. Std.	lt. than std.	com-pare with #0	com-pare with #0	compare with #1 very cloudy	water
Recommendation:	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	Ch	

of the Lubrication Laboratory, machines of this type have been grouped together and are changed every three months without an analysis of the oil. One other small group of machines were separated from the main group. These machines, with very small reservoirs and rather light usage, were recommended for oil changes once a year without analysis of a sample.

Basis for Change

The basis for recommending the change or continued use of the hydraulic fluid was set arbitrarily at first, but subsequent work and experience has proven it valid. The oil is considered satisfactory for continued use if the viscosity is within plus or minus ten percent of the original, if the acid number is below 0.25, and if visual inspection or appearance shows there is no water or dirt being carried in the oil. Any fluid which shows greater viscosity change, higher acid number or that carries water or other foreign matter, is considered unsatisfactory.

The change in viscosity is the most common cause for changing oil. This is caused primarily by contamination or by the operator inadvertently adding the wrong oil. Where the viscosity has changed, the acid number in very few cases has been great enough to indicate appreciable breakdown of the oil.

The original arbitrary criterion of a maximum number of 0.25 has been well supported by laboratory data. The characteristic curve obtained in the oxidation test used for evaluating turbine oils (A.S.T.M. Oxidation Test D 943) indicates that by the time an oil has reached an acid number of 0.25, oxidation is taking place rapidly (Figure 4) and that the oil may cause serious difficulty at any time.

The effect of water or dirt in the hydraulic system requires no further comment.

In the case histories that have been built up over the past several years, it has been found that each type of machine has a characteristic which is followed by the majority of the machines of that nature. However, individual machines may vary widely in their operating characteristics from the rest of the machines of that type. This usually appears to be a characteristic of the machine rather than surrounding conditions. Of course, the type of work being done and the surrounding conditions often determine the useful life of the hydraulic fluid.

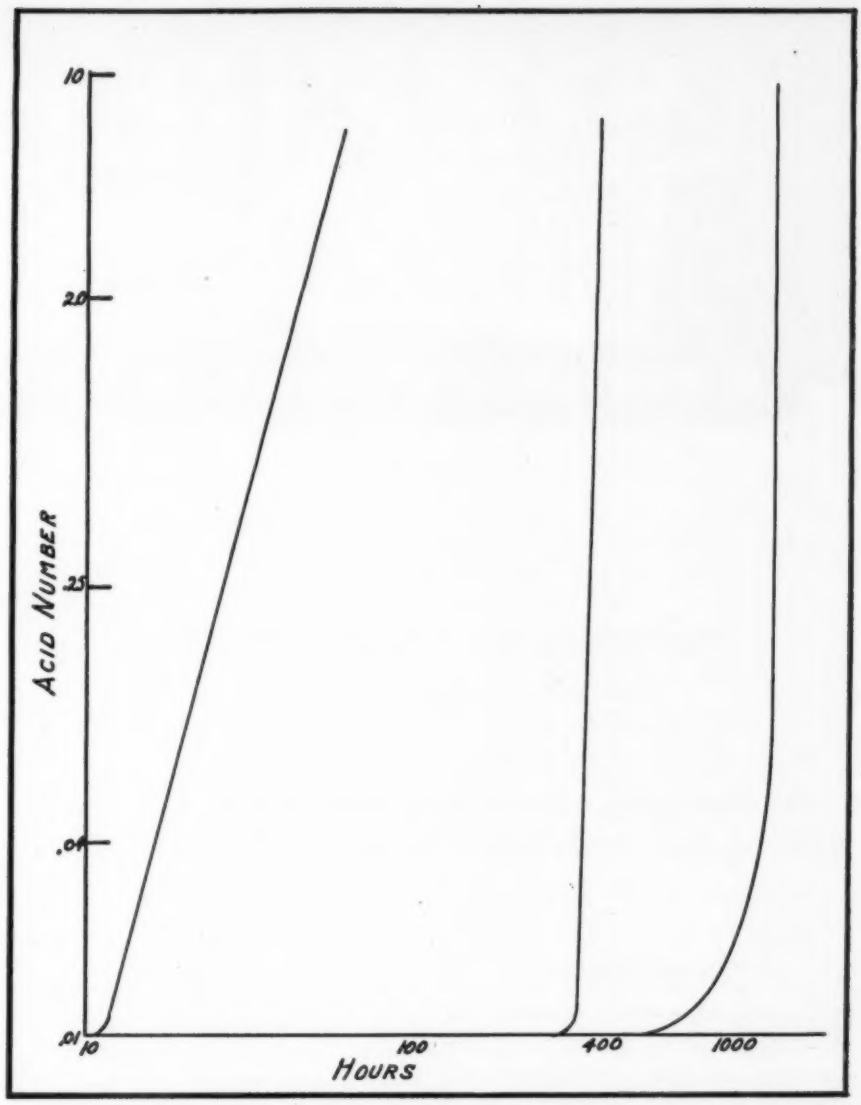


Fig. 4. Characteristic curves obtained with A.S.T.M. Turbine Oil Oxidation Test D 943 support the practice of changing oil when the acid number reaches 0.25.

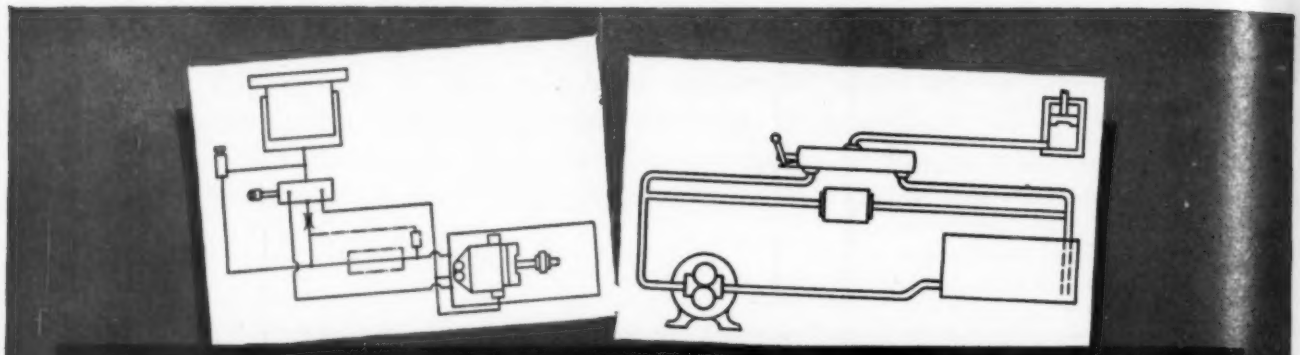
The oils in general use are straight mineral oils with a viscosity index of approximately 95 and that require approximately 500 hours to reach an acid number of 2.0 in the A.S.T.M. Turbine Oil Oxidation Test. In a few cases where difficulty has occurred with moisture collecting in the reservoir, with subsequent rusting, oils with corrosion and oxidation inhibitors have been used to good advantage.

This program includes approximately 300 hydraulic machines in this plant and has not only provided a means of protection for the machines but has provided much information on the characteristics of the machines. As has been pointed out, some machines require changes every three months, others have operated for as long as 30,000 hours without requiring a change.

The program for control of hydraulic fluids has been of great assistance in keeping hydraulically actuated machines operating at optimum efficiency, it has practically eliminated machine downtime due to oil failures and has proven a sound investment in helping to maintain production through the pressure of war, the postwar readjustment and the present schedules at a high level.

Acknowledgment

The author appreciates the support and cooperation of the Research and Tool Divisions in the development and execution of this program. The assistance of Dana Forinash in the preparation of this article is also appreciated.



A Beginner's Course in Basic Hydraulics

Chapter III

PRESSURE GAUGES AND VOLUME METERS

Part 1

The principles, construction, operation and care of the Bourdon and the Schrader pressure gauges.

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Pressure Gauges

PRESSURE GAUGES ARE USED in hydraulics to measure system pressures so that operators of hydraulic equipment can maintain pressures at safe and efficient operating levels. Any excess or deficiency of pressure should immediately be investigated with a view to locating and removing the cause of the trouble.

Gauge pressure and absolute pressure. When the type of gauge in ordinary use reads, for example, 30 psi, the reading applied to the liquid pressure set up by the opposition of forces within the system. Atmospheric pressure also acts on the system, but it can be ignored in practical operation because its action at one place is balanced by its equal and opposite action at another place. When it is taken into account in scientific calculations, the pressure of the system is referred to as absolute pressure. In these lessons, however, we confine our attention to gauge pressures.

Bourdon Pressure Gauge

Principle of the gauge. A tube, oval in cross section and formed in a circular half-turn, is used in a pressure gauge and is called a Bourdon tube. The Bourdon gauge works on the principle that pressure in a curved tube will tend to straighten it out. Figure 39 illustrates the simplest form of the Bourdon tube, with the pressure line connected to the fixed end of the tube; the other end with a connector for the linkage is free to move. The free end is connected by a linkage bar by levers and gears to a pointer.

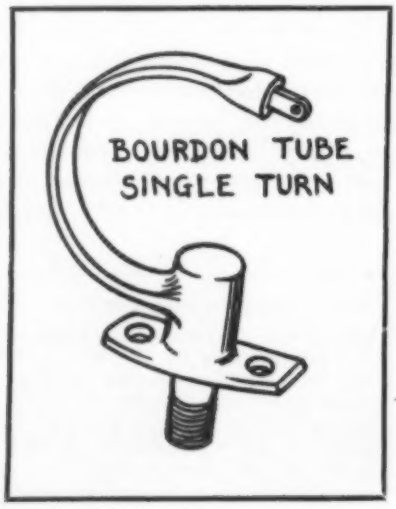

Fig. 39. The bare Bourdon single turn tube is oval in cross section and is bent into a circular arc.

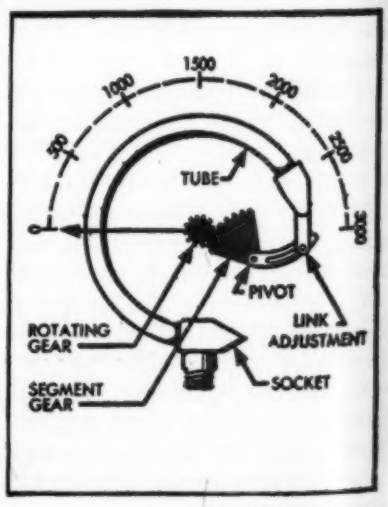

Fig. 40. The working parts of a Bourdon tube showing the mechanism by which the pointer is moved to indicate pressure readings.

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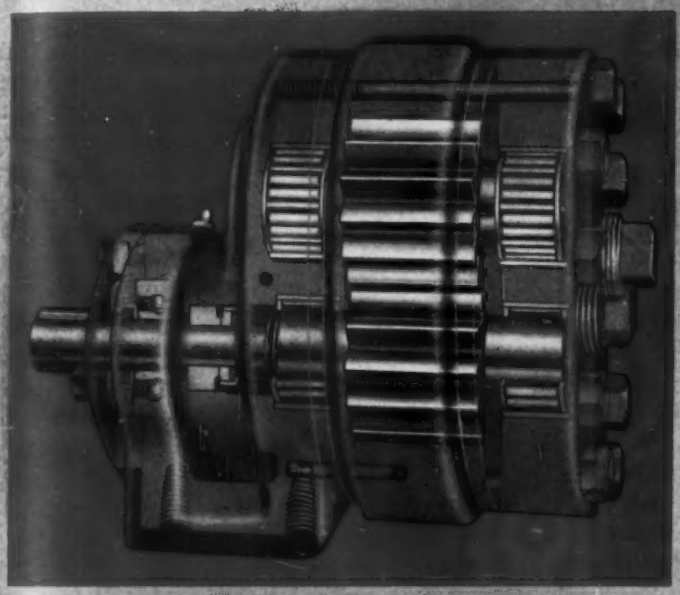

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(Continued from page 10)

The construction and material of the tube causes it to have a spring action; being suited to the range of pressures encountered with a given installation, the pointer will move to indicate an applied pressure and will return to its original position or zero reading for the pointer, when the pressure is removed.

A pressures when applied acts equally on every square inch of area in the tube. Since the surface on the outside of the curve is greater in area than the surface on the inside or shorter radius, the force acting on the outside of the curve will

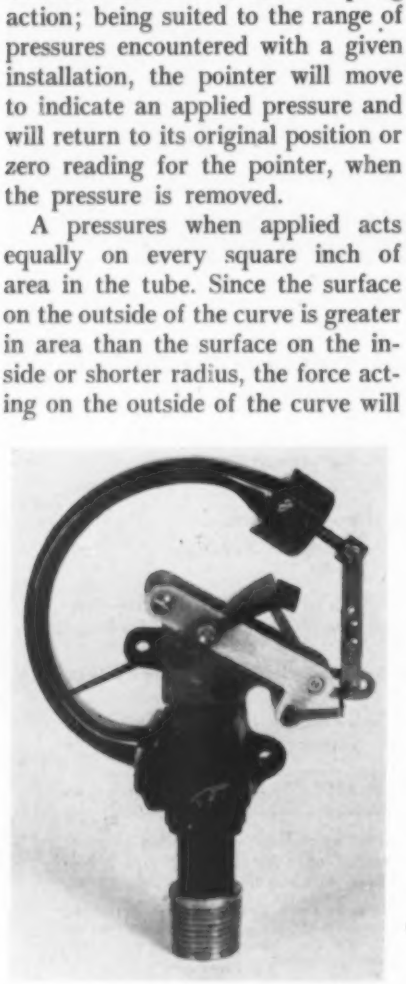


Fig. 41. A standard precision pressure gauge with worm gear micrometer adjustable pointer is accurate to within one-half of one degree reading over the full 270 degree dial arc (ASME Grade AA test gauge accuracy).

Courtesy, United States Gauge

be corresponding greater than the force acting on the inside. When pressure is applied the tube will straighten out until the difference in force is balanced by the elastic resistance of the material composing the tube. If a pointer is attached (Figure 41) to the tube and a scale is laid out on which the pointer can register pressures, we have the main elements of a Bourdon gauge.

Description of the gauge. Figure 40 shows the working parts of a Bourdon gauge. The tube is bent into a circular arc. The tube works by differential areas as described. The open end of the tube passes through a socket which is threaded so that the gauge can be screwed into an opening in the hydraulic system. The closed end of the tube is linked to a pivoted segment gear in mesh with a small rotating gear to which a pointer is attached. Beneath the pointer is a scale reading in psi. The gauge is calibrated against known pressures to insure accurate readings. The working parts are mounted in a metal case with the dial visible through a glass face. Under pressure the tube bends to straighten and the segment gear moves about its pivot, rotating the meshing gear and the pointer. The link adjustment between the segment gear pivot and the end of the tube can be set to make the gauge read correctly for known pressures. The pointer can also be loosened on its shaft and set so that the gauge will stand at zero when no pressure is being applied.

Care and use. The Bourdon gauge is made in various sizes. It can be manufactured cheaply for general use, or it can be made more carfully for precision work (Figure 41). Precision types are satisfactory for measuring high pressures, since they can be made accurate to about 0.25 percent of the full scale reading. Bourdon gauges of all kinds need frequent resetting. Calibration is accomplished by applying known pressures on a dead weight gauge tester and adjusting the pointer to read accurately.

The gauge should be protected from vibration, from excessive temperatures, from corrosive liquids and from sudden high pressures. Liquid should be introduced into the gauge by slowly opening the petcock in the gauge line.

Schrader Hydraulic Gauge

The Bourdon gauge is a delicate instrument and can be damaged very easily. In addition, as the range of hydraulic applications widened to include systems where the pressure fluctuates rapidly, the gauge sometimes caused trouble. The Schrader direct action gauge was developed for general hydraulic use, particularly for taking care of fluctuating loads.

Fig. 43. Enclosed (left) and standard types of Schrader hydraulic pressure gauges.

Principle of the Schrader gauge. In the Schrader gauge a piston is directly actuated by the liquid pressure to be measured and moves a cylinder against the resistance of a spring, carrying a bar or indicator with it over a calibrated scale. In this manner all levers, gears, cams and bearings are eliminated and a sturdy instrument can be constructed.

How the gauge operates. Figure 42 shows the construction of the gauge and the manner in which it operates. The parts up through the center of the gauge, from the needle at the bottom on through the packing piston and rod to the button at the top, forms a unit which transmits hydraulic pressure to the sleeve against which the button rests. This sleeve surrounds the inner barrel of the gauge, and is flanged at its base to provide a seat for a spring coiled around the barrel, and for a cup to which the pressure indicator is attached. Hydraulic pressure compresses the spring and the barrel rises out of the body, carrying the indicator with it. The indicator moves against a pressure scale on the face of the gauge.

Calibration. The Schrader gauge

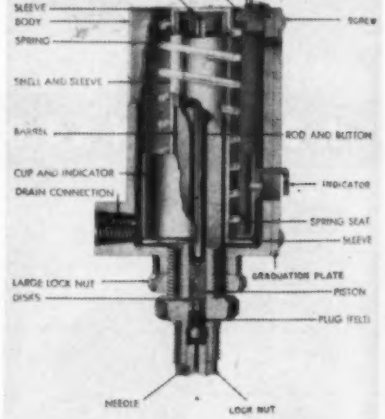
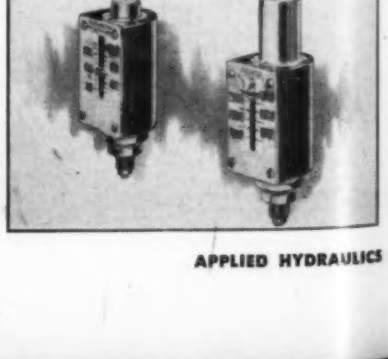


Fig. 42. The construction of the Schrader hydraulic gauge, a piston type, spring return, for general purpose pressure measurements.



is calibrated by comparing gauge readings with known pressures. A small error can be corrected by loosening the four screws on the face of the gauge (Figure 43) and sliding the scale up or down under the pointer. For larger errors, the adjustment screw which holds the spring in place can be tightened if the gauge reading is too large, or loosened if the reading is too small.

Disassembly. The inner core of the gauge can be removed for cleaning or for replacement of parts by loosening the small lock nut at the base and the large lock nut just above it, and then unscrewing the barrel from the body. In removing parts, be sure to observe their relative positions as shown in Figure 42. In reassembly, the barrel is rescrewed into the body until the indicator marker moves 1/16 in, after which the large lock nut is tightened.

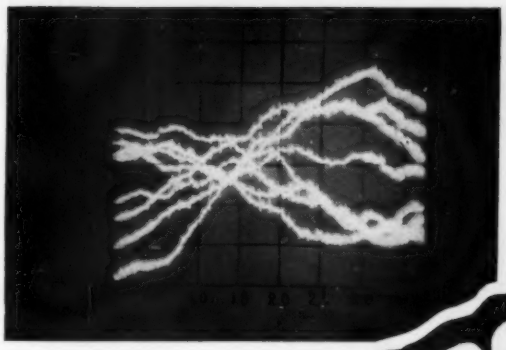
The other interior parts can be reached by removing the face plate and then unscrewing the adjustment screw nut, after breaking the solder seal of the sealing strip. The exact position of the adjustment screw nut should be marked on the casting with a knife or chisel, so that it can be properly positioned when the sealing strip is resoldered.

Applications. While the Schrader gauge is satisfactory for ordinary hydraulic pressure measurements, it is not as accurate as the Bourdon gauge. It is not a laboratory gauge for exact readings, but a sturdily constructed working unit suitable for practical use.

The gauge should be protected against vibration, excessive temperatures, corrosive liquids and sudden high pressures. A petcock should be installed between the gauge and the pressure system so that pressure can be applied slowly to the gauge, and so that it will be protected against strain when not in use.

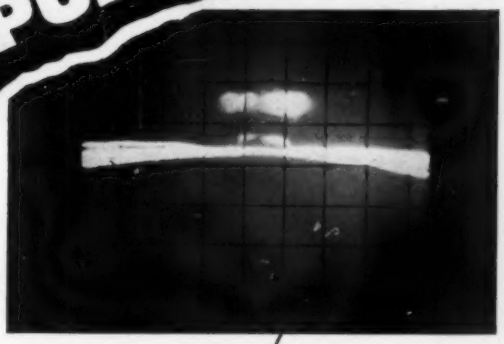
General precautions. Gauges should not be used on a system whose maximum pressure may exceed the maximum designated gauge reading. Dropping a gauge may permanently damage the calibrated units. When gauges are not in use they should be stored in a dry place.

Part II of Chapter III on volume meters will appear next month. Be sure to preserve each installment for future use.



BEFORE INSTALLATION OF ACCUMULATOR
Horizontal graduations equal 50 psi and full sweep equals 0.3 seconds. Without accumulator the maximum pressure swing of the surging fluid is 350 psi.

HOW TO IRON OUT PUMP PULSATIONS



AFTER INSTALLATION OF ACCUMULATION
Same installation with accumulator in system, the maximum pressure swing was reduced to 20 psi.

Pressure surges and pump pulsations are the two most common causes of pipe lines and hydraulic system failures. Surges and pulsations, however, can be greatly minimized or eliminated by installing a Greer Accumulator in the system. A simple "T" connection is all that is necessary to install it in any existing or newly designed circuit.

The "Before" and "After" photographs above give vivid proof of the effect of accumulators in hydraulic systems. A hydrauliscope and camera attachment were used to photograph the surges and pulsations of an actual pumping circuit. The "Before" picture shows the high degree of pulsations in the line not using an accumulator. The "After" picture shows how these surges and pulsations were effectively ironed out and virtually eliminated by the use of an accumulator.

Similar tests can be performed in your own system to demonstrate the effectiveness of a Greer Accumulator.

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Fig. 1. Interior of mobile "college".

COLLEGE OF CYLINDER KNOWLEDGE

THE MILLER MOTOR COMPANY HAS on tour a mobile "College of Cylinder Knowledge", a traveling exhibit of the company's air and hydraulic cylinders in actual operation. Housed in a 33 foot long house trailer, the exhibits were planned to do a thorough job of on-the-spot selling and to gain an acceptance for Miller cylinders among executives, engineers, designers, operating and purchasing executives. The second purpose of the exhibits is educational. Trained attendants demonstrate how cylinder breakage, leakage and damage to seals and other components can be eliminated, eliminating costly downtime, repairs, maintenance and replacements.

Visitors see leakproof air cylinder operation demonstrated by a standard model cylinder operating completely submerged in water in a transparent plastic container (Figure 1). The absence of air bubbles gives visual evidence of leak-proof operation. The actual plant test is duplicated for the visitor. An air cylinder is cycled at 5 psi, then at 80 psi line pressure and checked for low friction and leakproof operation by means of a flexible hose connected to a cylinder with the other end of the hose immersed in a glass of water, Figure 1.

A leakproof hydraulic cylinder operation is shown also. A 2000 psi hydraulic cylinder is hand pumped up to 5000 psi, duplicating the plant inspection-test procedure, then tested up to 10,000 psi.

Extremely low friction tests for both air and hydraulic cylinders are part of the exhibit. A booster unit by which a 2000 psi hydraulic ram pressure is readily obtained and maintained from an 80 psi air operated booster is also shown.

A unique feature of the mobile unit is the anti-side sway installation which permits an ordinary passenger car to pull the heavy weight of the long trailer easily and safely. Two Miller hydraulic cylinders are installed on the hitch, one on each side, Figure 2. Cylinder ports are interconnected by flexible hose, the action of the cylinders has effectively eliminated all side sway when driving.

The mobile "college" has covered Chicago and the Far West and will tour Boston, Northern Michigan and the Detroit area during September.

Fig. 2. Interconnected cylinders for eliminating side sway.

National Conference on Industrial Hydraulics

The tentative program for the fifth annual National Conference on Industrial Hydraulics, which will be held on October 26 and 27 at the Sheraton Hotel in Chicago, has been completed according to an announcement by Otto J. Maha, conference director. The conference is sponsored by Armour Research Foundation of Illinois Institute of Technology and the Graduate School of the Institute with the cooperation of seven Chicago technical societies: American Society of Civil Engineers, American Society of Mechanical Engineers, Society of Automotive Engineers, Western Society of Engineers, American Society of Lubricating Engineers, American Institute of Chemical Engineers and the Institute of Aeronautical Sciences. Morning and afternoon sessions on the two days will hear papers on recent developments, hydraulic equipment components, design considerations and hydraulic circuit performance, a total of 12 papers. Luncheon programs for the two days will cover a definition of the field of industrial hydraulics and a discussion of industrial plant progress resulting from JIC Hydraulic Standards. The program is believed to be the most comprehensive and practical one arranged to date. Copies of the complete program will be available shortly from the Public Relations Department, Illinois Institute of Technology, 3300 South Federal St., Chicago 16, Ill.

National Metal Show to Meet in Cleveland

The 31st National Metal Congress and Exposition will be held in Cleveland's Public Auditorium from October 17 to 21. The Metal Show, featuring "Economy-in-Production", will have over 300 exhibits totalling over 9 acres of operating displays. A feature will be the "Economy Theatre" in which exhibitors will run films on techniques and processes throughout the show. The sponsoring societies are the American Society for Metals, American Welding Society, Metals Branch AIME and the Society for Non-Destructive Metals.

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Make your selection with the help of our latest pump catalog. It includes illustrations, complete descriptions, installation dimensions and charts showing performance characteristics. Brown & Sharpe Mfg. Co., Providence 1, R. I., U.S.A.

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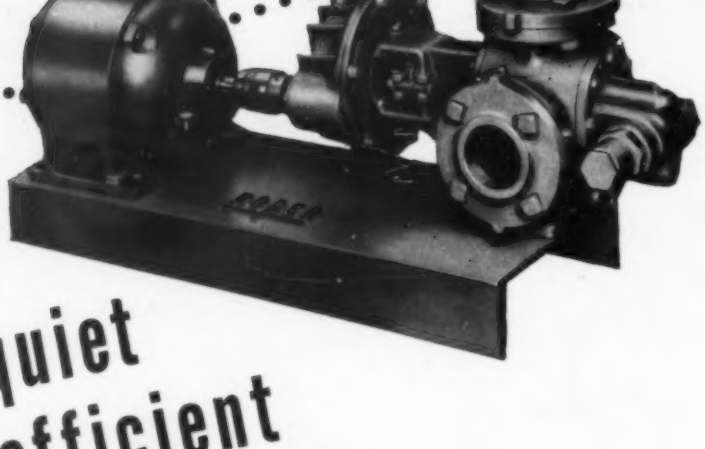

quiet efficient dependable

The Roper, 3600 Series, Pump illustrated above is a motor-driven unit with totally enclosed anti-friction gear reduction, mounted on a steel bedplate. Furnished with or ready to receive a standard motor. Capacities from 40 to 100 g.p.m. Other models in double and multiple units also available.

Roper motor-driven pumps are highly efficient for pumping oils, greases, solvents, thinners, paints, syrups, etc., in industrial plants and process industries. They handle a wide range of thick or thin clean liquids efficiently, quietly, economically.

Roper dependability is assured by design simplicity and time-proved features such as self-lubrication, extra deep packing box, adjustable relief valve, anti-friction shaft and thrust bearing, axial hydraulic balance, etc.

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SEE OUR CATALOG IN SWEET'S

ROPER
Rotary Pumps

LETTERS *to the Editor*

Some parts of our product are such that no oil or greasy substance dare touch them. When necessary to use oil, it must be "water soluble oil" that can be washed off with steam and soap-water.
Around our hydraulic equipment we are having trouble with leaked oil getting on the product. Could you tell us of any water compound to be used in the hydraulic tank, pump and cylinder system to replace the oil.

C.H.B.

We have checked with several hydraulic oil specialists whose concensus of opinion is that a water soluble oil or water compound should not be used in a hydraulic system to replace the oil. The gain in lubrication and the elimination of the corrosion problem were important factors in the replacement of water hydraulic systems by oil hydraulic systems. Components, particularly valves, in oil hydraulic systems have been designed to operate in grades of oil with specific characteristics. One machine tool engineer consulted recommended that you ask your maintenance department for suggestions regarding packing changes, isolation of coolants or lubricants and hydraulic fluids, the routing of piping to reduce surges or other features of operation which may reduce oil leakage.

Is there a directory of manufacturers of hydraulic components and systems? We would be interested in a list of pump and valve manufacturers for high pressure work.

J.K.

No general directory exists; the Air Material Command has just issued a new group of 27 catalogs listing in detail items used by the Air Force; this is the nearest to a directory. However, The Hydraulics Publishing Company, publishers of this magazine, is compiling some lists of this nature.

I miss the book reviews in APPLIED HYDRAULICS, especially since so few books on hydraulics are reviewed elsewhere. Can't you squeeze in a few now and then?

J.K.

The space problem forced us to drop our book reviews temporarily. We will resume reviews when space is available. For your and other readers' information, two recent important books published may be of interest: "Engineering Applications of Fluid Mechanics" by J. C. Hunsaker and B. G. Rightmire, published by McGraw-Hill Book Co.; and "Aircraft Electrical Systems, Hydraulic Systems and Instruments" by Col. R. H. Drake, published by The MacMillan Company.

We have received a number of letters on our Beginner's Course in Basic Hydraulics which indicate the popularity of this feature in APPLIED HYDRAULICS. We quote briefly or in part from a few:

I believe articles such as you are running in your more recent issues describing the fundamentals behind hydraulic systems is to be of great value. We have found so many times that people think all a hydraulic system requires is a pump and a globe valve to make it work and are surprised to learn how a hydraulic circuit behaves and what is necessary for proper control.

E.W.C.

Your magazine has been received regularly and its articles are very informative. If there is any one thing that we would like to single out for specific commendation, it is the course in basic hydraulics that you are running serially. We hope that this will be continued and extended to cover basic design problems in various applications.

M.R.W.

We are particularly interested in your "Beginner's Course in Basic Hydraulics" which our engineers find very interesting as well as useful.

J.C.E.

There seems to be some confusion among salesmen who sell pipe and fittings as to whether their products meet J.I.C. Standards. It may be just us that are confused. We are passing along a question our customers are beginning to ask—"shall we insist on J.I.C. Standards?"

T.J.

Manufacturers and suppliers of pipe and fittings will tell you whether their products meet J.I.C. Standards. Some do with their present equipment; others are making design changes to comply; still others are studying the problem, making analyses of their applications and prospective applications. The J.I.C. Standards, like any standards, are an index of thinking of specialists plus a mean of their experience directed toward a simplification and standardization of design, construction and application techniques.

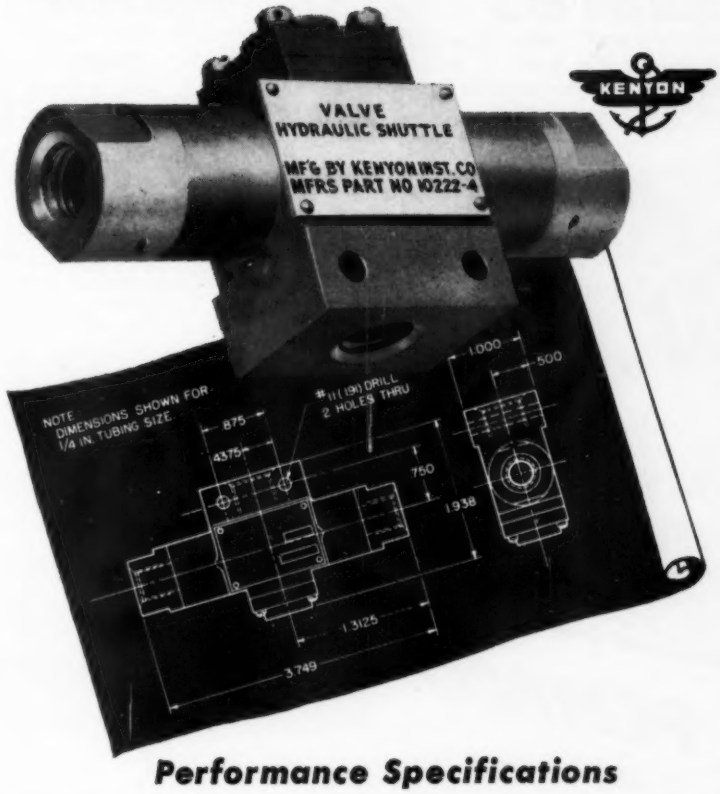
I am trying to sell my department head on the fact that the papers and personal contacts with leading hydraulic engineers at the National Conference on Industrial Hydraulics is valuable enough for my company to send me to this meeting. I need a copy of the program to help me do this. Where can I get a copy?

O.R.

We are sending an extra copy of the program, just received. Readers may obtain copies on request. See the story on the Fifth Annual National Conference on Industrial Hydraulics elsewhere in this issue.

We are sorry to report that our supply of copies of the March, April and May issues—containing the first three articles of the series "Beginner's Course in Basic Hydraulics"—has been exhausted. We are still getting many requests for these issues which we are unable to fill.

3,000 psi
SHUTTLE VALVE



Performance Specifications

✔ **SHUTTLING PRESSURE**
Valve shuttles at a maximum pressure of 50 psi.
Valve will not shuttle or permit inter-flow at pressures less than 25 psi.

✔ **SURGE FLOWS OR NEGATIVE PRESSURES** will not cause the shuttle to unseat.
Surge flows will not displace the seals.

✔ **LEAKAGE**
Less than two drops per cycle.
Static leakage (air or hydraulic fluid)—None.
Air leakage during shuttling—Less than 10 ml per cycle.

✔ **IMPULSE TEST**
No leakage or deterioration after 20,000 impulses.

✔ **SHUTTLING AGAINST PRESSURE**
Valve will shuttle against blocked line.

✔ **ENDURANCE**
No excessive wear or malfunctioning after 2,000 shuttling cycles.

✔ **EXTREME TEMPERATURE OPERATION**
Temperature range −65°F to +160°F.

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Less than 10 psi. at rated flow.

✔ **WEIGHT**
1/4 and 5/16 inch tube sizes .48 lb.

✔ **SIZE**
Envelope and mounting dimensions according to AN 6277 or to meet requirements.

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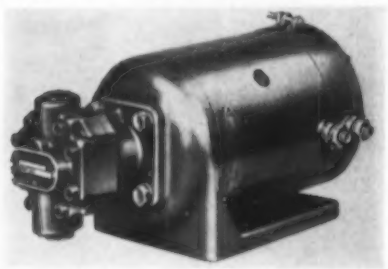
New PRODUCTS

For additional information on any of these products, mark the end key numbers on the card bound in this issue and mail the card.

Rotary Gear Pump Unit

A new addition to the line of Constant-Flo rotary gear pumps, Type GC, is announced by the John S. Barnes Corporation. The new member is a pump and motor unit exactly mated,



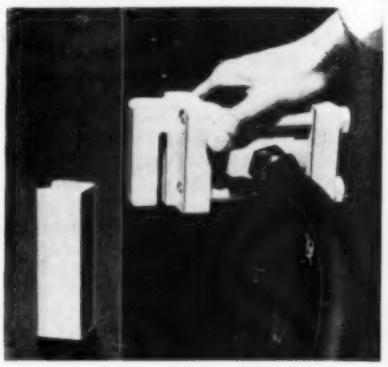
assuring maximum efficiency of both pump and motor. The pump is available in ½ in or ¼ in ports with built-in relief valve with special ports and mounting brackets to suit application; capacity is 2.5 gpm at 650 psi or 2.0 gpm at 1000 psi, maximum pressure 1500 psi. The 12 v series wound motor is of exceptionally sturdy design. Catalog sheets given complete engineering data are ready for distribution. *1.*

New Tube Fittings

A complete line of new Triple-lok tube fittings comprising 477 shapes and sizes is now available, according to an announcement by The Parker Appliance Company. Specially designed to meet the J.I.C. Hydraulic Standards for Industrial Equipment, the Triple-lok fitting has successfully undergone the AN-F-47 test specifically required under the new standard. The Triple-lok is a three-piece all steel flared fitting with a sleeve which acts as a lock-washer, damps vibration and prevents wiping of the flare during make-up. Sizes range from ⅛ in tube OD, ⅛ in pipe thread to 2 in OD and pipe thread. *2.*

Quick Attachment Vibrator

The Cleveland Vibrator Co. announces the availability of a Type "UH" pneumatic vibrator that can be quickly attached to or removed from units that require vibration or for use with equipment where vibrator installation cannot be permanent. The "UH" vibrator is equipped with a rugged milled steel hook for attachment in the female brackets which can be welded or bolted to the unit to be vibrated.



Obtainable in a 2 in piston size, the unit operates efficiently on continuous line pressure of 50 to 100 psi; rate and intensity of vibration is controlled by regulating the air pressure. At 80 psi, the unit develops approximately 1200 blows per minute, consuming about 10 cfm in continuous operation. *3.*

(Continued on page 24)

PEMACO HYDRAULIC and AIR CYLINDERS

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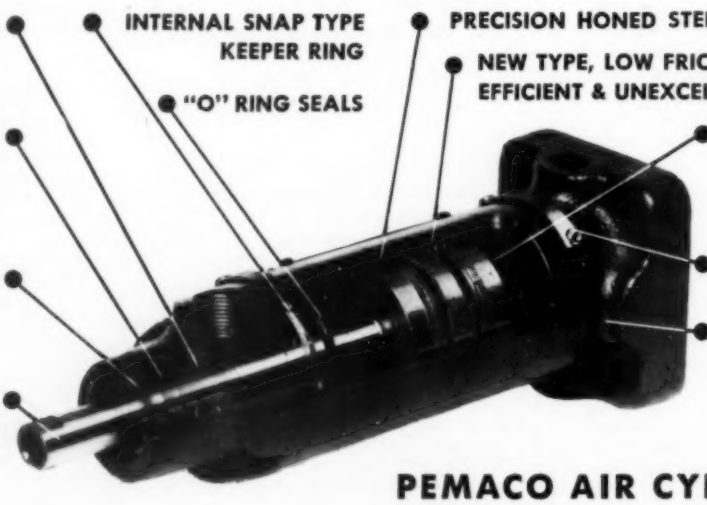
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An exclusive feature is the one piece piston construction. Other makes using synthetic or leather cups usually have a piston made of three pieces...and thus cannot maintain 100% concentricity.

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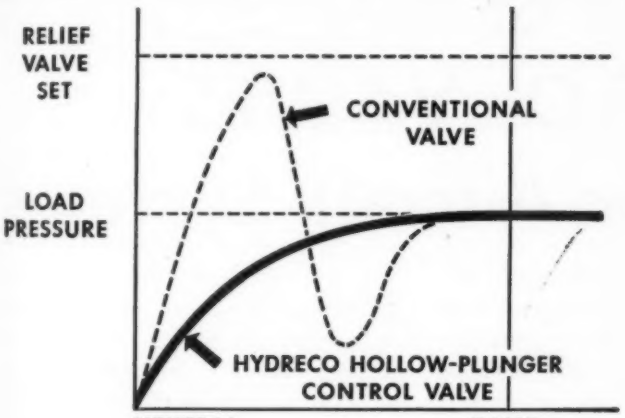
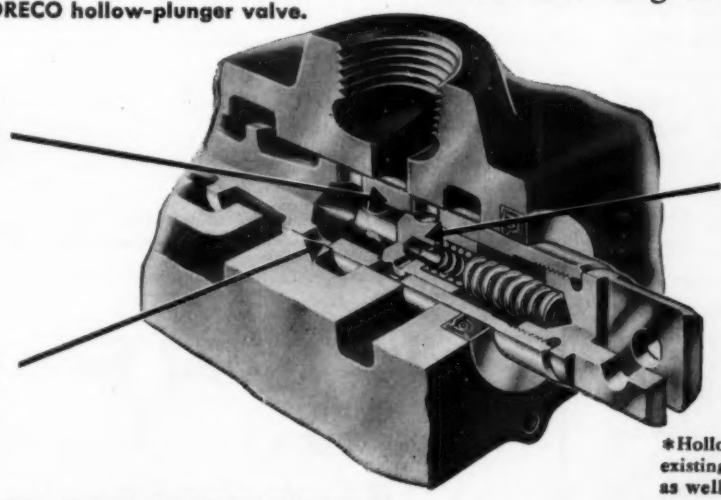
HYDRECO HOLLOW-PLUNGER* CONTROL VALVE



Graph of pressure rise during plunger travel for both conventional valve and HYDRECO hollow-plunger valve.

THAT HOLDS THE LOAD WHILE THE OPERATING POSITIONS ARE CHANGED

In the HOLLOW-PLUNGER control valve, with built-in checks, the cylinder port opens before the neutral port is closed—without dropping the load. Constant pressure rise, from neutral to full operating position, favors careful throttling or *smooth* quick action.



Patented hollow plunger with no dead spots to create pressure peaks.

Check valve assembly prevents pressure drop in the cylinder while pressure port is opening.

Circular ports are staggered in the plunger for accurate throttling.

***Hollow-Plunger protected by existing U.S. and Foreign Patents as well as patents applied for.**

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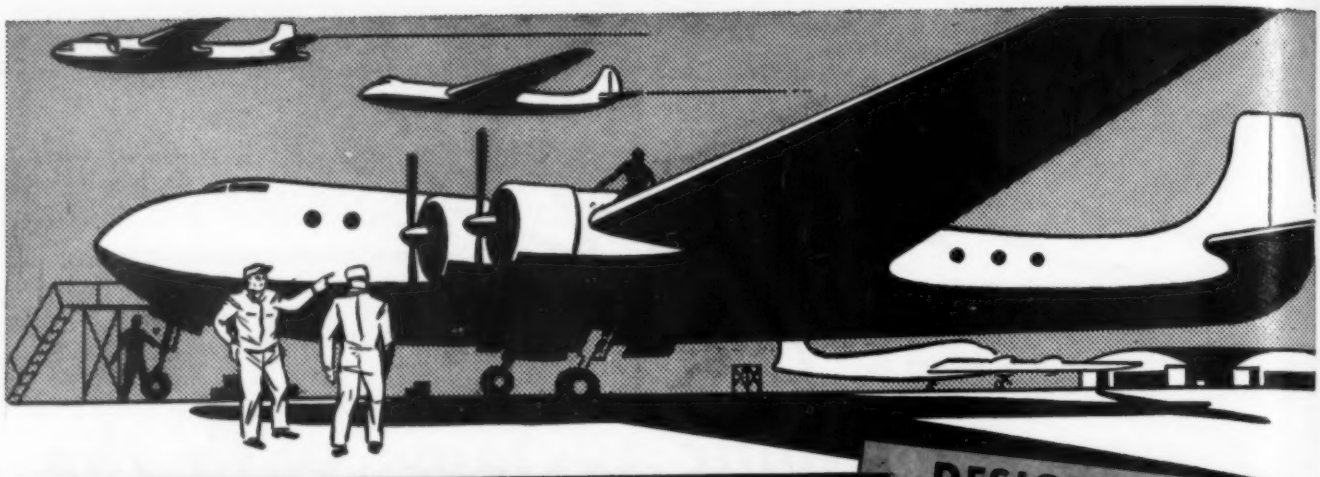

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FRED O. HOSTERMAN
Advisory Editor

Qualification Testing of FLUID CONTROL VALVES For Aircraft Systems

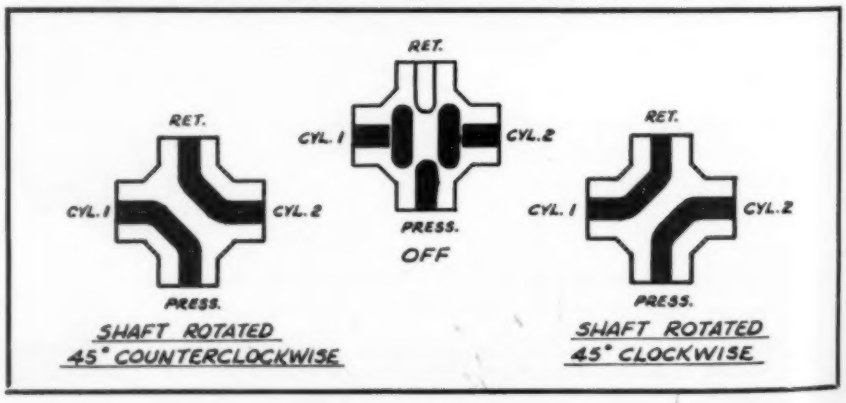
By FRANK P. McCORD

As the size and complexity of modern airplanes have developed to the proportions seen today, so too has the auxiliary and automatic control equipment which makes it possible for the human pilot to direct the flight of inconceivable masses of aircraft, cargo and passengers through the air. Before proceeding with a more detailed discussion of the qualification testing of a specialized group of this equipment, fluid control valves, a brief summary of some of the types and their uses in the intricate workings of a modern airplane may be of some interest.

Perhaps the best known of the various valves in common use at the present time is the ordinary four-way type. This unit, when connected in a hydraulic or pneumatic circuit, controls the direction of motion for double acting cylinders in such operations as raising and lowering landing gear, opening or closing bomb doors, cowl flaps, and so forth; they are also used for raising and lowering wing flaps, dive flaps, and, in a modified version, as a means for controlling the movement of the main control surfaces of some of the larger aircraft.

In case of the four-way valve, the overall design growth of the airplane has been reflected in the need for remote control or automatic operation of this type of unit in many instances. This is especially true where it has been necessary to locate valves at points in the airplane inaccessible to the pilot but yet responsive to his control. The design development of these units has successfully accomplished this function in various ways. The most popu-

Fig. 1. The flow diagram of a typical rotary type four-way valve.



How types of aircraft fluid control valves are tested for performance under extreme climatic and endurance conditions; the purpose of qualification testing, with highlights on the uses of these valves, specification requirements, test methods and test equipment is discussed.

lar method has been by means of electricity, either with a motor driven actuator to operate the standard manual type of rotary valve, illustrated diagramatically in Figure 1, or directly, as in the case of the solenoid operated slide type valve shown in Figure 2. In the majority of instances, the rotary type selector valve is manually operated, either directly or by means of levers, pulleys and cables. The motor driven actuator has come into more prominent usage as a means of operating engine oil and fuel shut-off valves since these units are of necessity located in areas of the airplane inaccessible during flight.

It is readily seen from the diagram of the solenoid valve, Figure 2, that the larger the flow passage in the slide, the longer the stroke of the solenoid must be. This fact definitely limits the use of this type of valve where flow requirements are high because of the inherent low efficiency of D.-C. solenoids as the stroke becomes longer. For example, on a solenoid operated valve with a one-half inch stroke, the weight of the solenoid is approximately 75 percent of the total weight of the unit. This condition has been partly responsible for the development of still another type unit involving the use of pistons on either end of the valve slide, thus providing a means of operating the valve through the application of pressure from an independent source or by utilizing the pressure being controlled by the main valve in a small solenoid operated pilot valve.

In all cases except for the motor operated units, which must be reversible, a spring is employed to store energy while the valve is being actuated in order that it may return to its normal position when the actuating force is removed.

To define the subject of qualification testing relating to fluid control valves, at least two viewpoints should be acknowledged. The first applies to a unit which has no definite application for a specific customer but which seeks to survey the need for a valve to perform an existing function in a more dependable or advantageous manner. The second refers to the testing of a specific item to establish satisfactory proof of performance in accordance with detail specifications drawn up for that purpose.

In either case, the problem is primarily one of research in which the manufacturer or the customer is interested in the functional design limits of a newly conceived item, or the adaptation of an existing design to a new application. It becomes the duty of the test engineer to evaluate or qualify the design by means of adequate tests. To describe all such tests required on each type of valve would result in an extremely lengthy discussion; however, an attempt will be made to summarize the overall requirements with special emphasis on unusual items of interest.

A few test requirements are applicable to nearly all valves. These include pressure drop, functional and leakage tests at extreme temperatures and endurance or life cycling tests at rated pressure and flow. For manual valves, the torque or load required to operate the unit at all pressures up to the maximum of design and at opposite extremes of temperature, is important. In the case of the electrically operated units, current drain and operating voltage are similarly important. Also, where contact points are employed, such as in the secondary or holding coil of a direct current solenoid, testing at atmospheric pressures equivalent to high altitude is required.

To enlarge on the explanation of some of the above tests, let us first consider pressure drop. This characteristic of all valves is perhaps one that taxes the ingenuity of designers as much or more than any other one feature. It may be defined as the loss in energy by the fluid in overcoming the internal friction of the valve, and it varies almost directly with the square of the velocity of fluid passing through the valve. Thus, the optimum design has large flow passages with all other parts of the valve as small as possible, since a loss in pressure due to pressure drop is a loss in power resulting in a lowered efficiency of the system. The rated flow of any valve depends to a great extent on line size. The desired flow rate in an aircraft hydraulic system has been defined by the Air Force-Navy Aeronautical Specifications AN-H-2b as such that the average velocity of oil in pressure lines leading to directional control valves

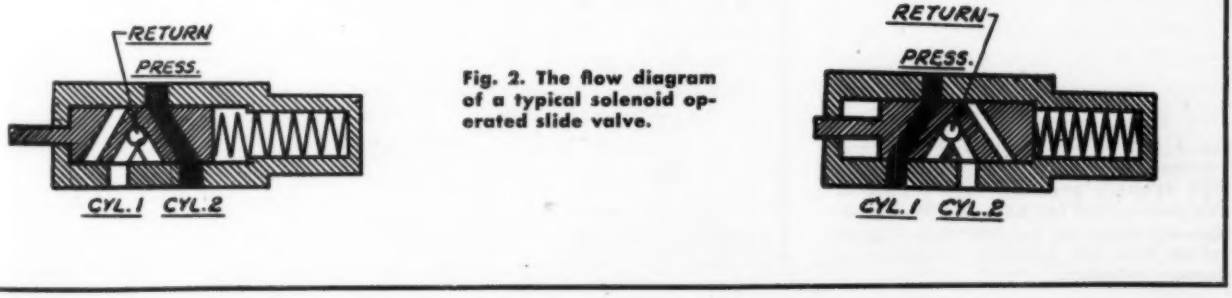


Fig. 2. The flow diagram of a typical solenoid operated slide valve.

does not exceed 15 feet per second. The following table indicates the desired average flow for various tube sizes:

Nominal Tube OD	Desired Average Flow
Inches	Gallons per Minute
¼	1.2
5/16	2.3
⅜	3.5
½	6.0
⅝	10.5
¾	16.0
1	29.0

It should be mentioned in passing, that since the advent of 3000 psi hydraulic systems in aircraft, many designers are giving flows in excess of these listed standards, particularly in the ⅜ and ½ in sizes. Values as high as 5.0 and 9.0 gpm respectively for these sizes are consistently being used where the working pressure is 3000 psi.

Pressure Drop

To measure pressure drop it is necessary to connect two straight lines of the rated size for the valve being tested to each port across which differential pressure is desired. For best results the length of these lines should be approximately 20 diameters on each side of the valve, with an additional 20 diameters each side of a pressure tap connection in the center. Fluid manometers or calibrated pressure gauges are used to measure the difference in pressure at the desired flow. The hydraulic test stands are equipped with power driven pumps and flow meters for conducting these tests. The flow meters used on these stands, which are ideal for this purpose, operate on the principle of the pressure drop around the annular area of a steel metering indicator wherein fluid is discharged through the annular aperture between the steel indicator and a graduated glass cylinder of controlled variable size. The height to which the indicator rises at any flow within the range of the instrument, determines the quantity of fluid flowing by the graduations on the cylinders which are calibrated specifically for the fluid being used. Some typical pressure drops curves are shown in Figure 3.

Since the common temperature range specified for nearly all valve types is from —65 F to 160 F, a specially designed controlled temperature chamber is used for conducting functional and leakage tests at extreme temperatures. Specimens can be mounted inside this chamber with pressure sources and actuating means being introduced through insulated ducts from the outside. Test temperatures are read and recorded from an indicating and recording electronic potentiometer which is capable of indicating temperatures within an accuracy of plus or minus one-half degree F.

For high temperature operation the test chamber is equipped with an electric heater and circulating fan. The heater switch is controlled by an adjustable thermo-regulator which, for elevated temperature tests, is set to maintain an inside ambient temperature of 160 plus or minus 2 degrees F.

For low temperature operation, the test chamber is provided with a dry ice container and blower located behind the heater. The refrigeration process consists of drawing air from the work chamber, over the dry ice and into the blower, which expells the chilled air back into the work chamber. The thermo-regulator, by controlling the blower, effectively regulates the ambient temperatures which, for this type of testing, is set to maintain the test area at not

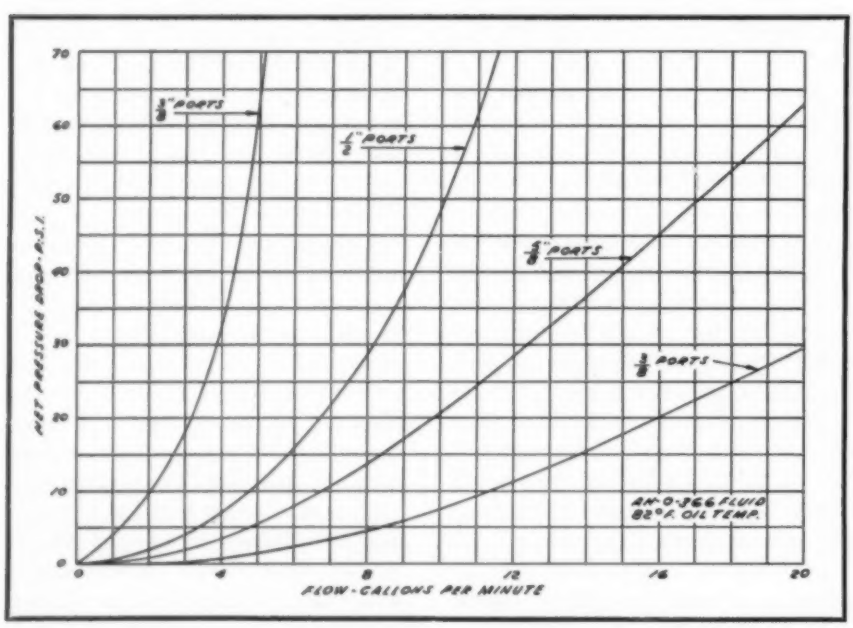


Fig. 3. Typical pressure drop curves through each flow passage of various sizes of rotary type four-way valves.

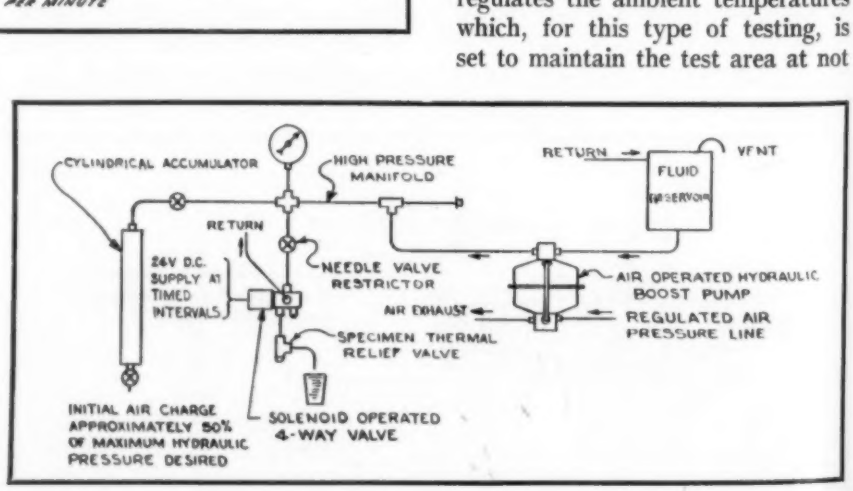


Fig. 4. A method of testing thermal expansion relief valves for endurance at high dynamic pressure. This system is also convenient for boosting dry nitrogen pressures to considerably higher values than are normally available in storage cylinders.

warmer than —65 F, although temperatures as low as —100 F are possible.

Endurance Cycling

In the case of endurance cycling of various types of valves each type presents a separate problem. This often involves numerous set-ups and the design or procurement of special equipment especially where it is necessary to simulate actual operating conditions as closely as possible.

An example of adapting special equipment to the solution of a problem involving endurance tests on a thermal expansion relief valve is shown schematically in Figure 4. In this case it was necessary to apply repeated pressure surges in excess of 4000 psi to cause the valve to relieve; then to reduce the pressure rapidly to allow reseating to take place. The problem arose from the fact that the power driven pump on the test stand is rated at 3000 psi and would be seriously overloaded if it were continuously operated at this higher pressure. The answer was found through the use of the bulb-shaped air operated pressure booster. With this unit, having a boost ratio of 100 to 1, it is possible to obtain a hydraulic pressure as high as 10,000 psi with application of only 100 psi air pressure. The unit is double acting and therefore ideal for maintaining high pressures at low flows.

In this application, an air pressure regulator kept the operating air pressure at approximately 40 psi, thereby controlling the high pressure output at the 4000 psi required. Hydraulic pressure output was pumped directly into the manifold of the test stand to which the test specimen was connected. An air charged accumulator, capable of storing a considerable volume of oil under pressure is also connected to the manifold, when desired, by means of a shut-off valve. This made it possible for a smooth flow of hydraulic fluid under pressure to be supplied to the thermal relief valve under test.

A solenoid operated four-way valve similar to that shown in Figure 2, was used to alternately direct a surge of high pressure to the test specimen and then relieve it again at timed intervals. This type of valve, in addition to being very useful for remote locations in an airplane, also is well suited to many types of cycle testing, particularly when used with an electronic cycle timer with which the "on" and "off" time of the external circuit can be varied in very small increments by means of simple dials. A convenient hook-up for obtaining variable dc voltages is shown in the diagram Figure 5. With such a circuit it is possible to obtain accurate readings of minimum operating voltages and current drain at the moment a solenoid actuates. In addition, this equipment will furnish a continuous source of power with practically no maintenance.

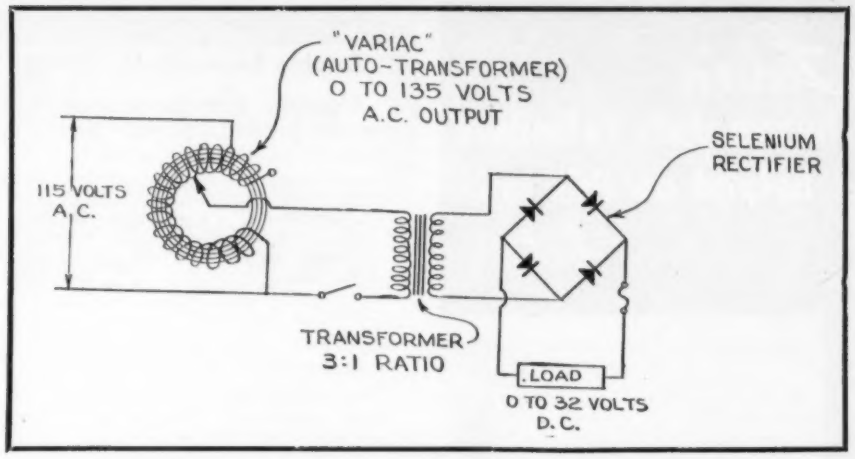


Fig. 5. Diagram of power conversion hook-up for obtaining variable dc voltages for testing.

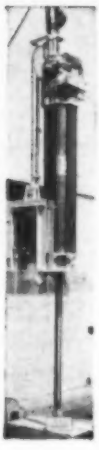
A typical method of testing the solenoid operated four-way valve itself for endurance cycling at rated pressure and rated flow consisted of alternately energizing and de-energizing the solenoid with a maximum of 30 volts applied, thus interchanging the flow of hydraulic fluid under pressure from one cylinder port to the other with the relief valve providing the load. A system of check valves installed in the circuit provided for the by-pass fluid from the relief valve to be routed back through the cylinder port to the return port of the specimen valve, while fluid under pressure is passing through the opposite cylinder port from the test panel. The total number of cycles generally required for endurance tests is 20,000 minimum.

Such a system naturally generates considerable heat. The heat is dissipated by means of a water cooled coil located in the reservoir of the test stand. The oil temperature must be maintained at 100 F plus or minus 20 degrees during this test with the exception of 4000 cycles which must be with oil at a temperature of 160 F plus or minus 20 degrees.

In general, qualification testing of valves designed for use with other fluids require similar procedures with various enlargements or modifications. For example, in the case of fuel valves, extensive immersion tests to determine resistance of various valve components to aircraft fuels are required; also, all electrically generated units with contact elements such as breaker points to cut out the primary coil of a solenoid, must usually be tested through a sufficient number of operations under high altitude conditions to insure satisfactory performance. A simple belljar and vacuum pump are readily adapted for this purpose.

When we consider the multitude of valves of every type scattered throughout the airplane to control or regulate the flow of fluids such as engine oil, fuels, hydraulic fluid, compressed air, alcohol, etc., with each type requiring various flow characteristics, port sizes, operating pressures and actuating methods, it is readily understandable why the development and manufacture of these units has become a tremendous specialized industry. Furthermore, since the customer, who is usually the government or subject to governmental regulations, requires satisfactory proof of performance for each such valve installed on his airplane, the procurement and compilation of satisfactory test data or qualification testing becomes a project of major importance.

Ledeen heavy duty cylinders helped do this job better



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APPLICATION—An 8" diam. x 42" stroke Ledeen heavy duty cylinder operates a large vertical gate in a copper mine. This gate must be kept open when plant power is on; closed under pressure when power is off.

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Ledeen heavy duty cylinders, operated by air, oil or water, will do it for you better and surer.

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Ledeen Mfg. Co.

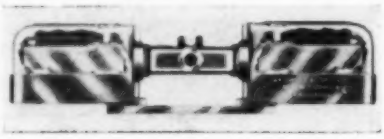
DIV OF ENGINEERING PRODUCTS CO

1600 SO. SAN PEDRO - LOS ANGELES 15, CAL.

(Continued from page 18)

Double Solenoid Air Valves

A new line of double solenoid valves for air pressures to 125 psi is announced by Valvair Corporation. The



valve has a one piece bronze base for each solenoid, heavy solenoids for positive seating and cool operation, "OU" type packer and shock-resisting clevis and clevis pin. The new valve is available in sizes ¼, ⅜, ½ and ¾ in, in two-way, three-way piped exhaust and four-way piped exhaust. *4.*

Rotary-Gear Hydraulic Pump

A new series of rotary-gear hydraulic pumps, designed to meet specific flow and pressure requirements of tractors, trucks and construction tools and applicable to other heavy-duty applications, is announced by Romec Division, Lear, Incorporated. Model RG-7380 of the new Lear-Romec line, illustrated, delivers 5 gpm at 1000 psi

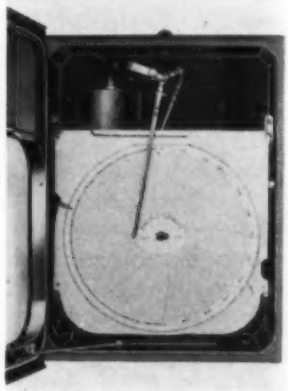
and 1800 rpm and will operate at a maximum intermittent pressure of 1500 psi. Case is aluminum alloy with closely fitted hardened steel impeller gears and lead-bronze bearings. A mechanical shaft seal incorporates an air-check device that prevents entrance of air during self-priming starts. Ports are tapped for pipe thread, ½ in NPT inlet, ⅜ in NPT outlet. *5.*

Reciprocating Pump Packing

Palmetto Pisto-Ring packing, designed to the particular requirements of inside-packed reciprocating pump service and tested and proved as a replacement for hydraulic duck and other forms of packing now in use has been added to the line of Greene, Tweed & Co. The manufacturer states that advantages include: molded to exact size, easy to install, flexibility and resiliency, heat resistant up to 450 F, self lubricating and impervious to lubricating oil, boiler feed water, most acids and alkalis. Pisto-Ring packing is available in 16 sizes. *6.*

Recording Absolute Pressure Gauge

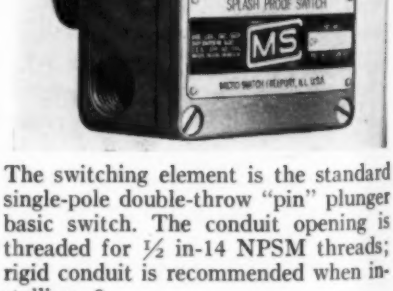
The Bristol Company announces the development of a mechanical-type recording absolute pressure gauge based on an entirely new principle, involving a pressure-sealed lever arm so constructed that it is frictionless, entirely free from lost motion and free of turning moments due to changes in differential pressure across it. Known as the Series 500 recording absolute pressure gauge, the new unit makes possible



the recording of extremely low absolute pressure ranges; it is offered in ranges from 0 to 20 millimeters mercury up. Rugged for ordinary plant conditions, the new instrument may be used as a recorder, an automatic controller and for remote measurement and automatic control of absolute pressure. *7.*

Splash-Proof Switch

A new heavy duty splash-proof precision switch with a plate type actuator and especially advantageous on equipment where operator safety demands two-hand control switches, is announced by Microswitch. The new unit, the OP-AR50, has a housing with a gasketed cover plate and a closely fitted actuator shaft through the housing wall which serve to protect the enclosed switch unit from the entrance of dirt, dust and the splash of oil, water or coolant.



The switching element is the standard single-pole double-throw "pin" plunger basic switch. The conduit opening is threaded for ½ in-14 NPSM threads; rigid conduit is recommended when installing. *8.*

Single Stage Centrifugal Blowers

The Air and Hydraulic Division of Lindberg Engineering Company announces the development of a com-

(Continued on page 28)

Useful Literature

The publications listed are available without charge. Mark the initial key number on the card bound in this issue and mail.

28. Hydraulic Tubing . . . Bulletin 38 issued by Superior Tube Company gives general and technical information, as well as specifications on the line of seemless steel hydraulic tubing made by this company. Hydraulic tubing from ⅛ to 1⅛ inch OD, in wall thickness for every practical operating pressure are stocked. Dead soft annealed tubing, temper No. 1, is furnished for hydraulic applications. All tubing is given a 100 percent hydrostatic test; each order is tested for flareability.

29. In-Line Master Valves . . . The line of air control valves made by Ross Operating Valve Company are shown in their Bulletin No. 302. Three-way and straightway in-line master valves are covered, each in six sizes, as well as the Ross pilot valves, also available in three-way and straightway types with control by hand push button, button or roller cam, mechanical or hand toggle, and in numerous types of head and body styles. Dimensional drawings, parts lists, and diagrams of typical three-way master valve installations are shown.

30. Packing Standards . . . A 32 page handbook on hydraulic and pneumatic standards for leather and synthetic rubber has been issued by E. F. Houghton & Co. The new manual, prepared by the Hydraulic Engineering Department of this company, supplements Houghton's two previous packing handbooks and includes data on "V" packings, both fabricated and homogeneous, leather "V" packings, leather and synthetic cup packings, synthetic "O" rings, synthetic "O" ring packings and gaskets, leather back-up washers, synthetic homogeneous "U" cup packings and leather "U" packings. Drawings of each type of packing and full specification data are given.

31. Hydraulic Equipment . . . Bulletin 110-C, issued by The Watson-Stillman Company, describes and illustrates the hydraulic forged steel fittings and valves, hydraulic and plastic molding presses, pumps, jacks, benders and accumulators made by this company. Valves and fittings are shown in some detail.

32. Air and Oil Filters . . . Air-Maze Corporation has issued Form FLC-749, an eight page catalogue-insert type booklet on their all metal, washable filters for air and oil. Panel, oil bath type and pipeline filters for air are shown and described. The Electromaze electrostatic dirt precipitator for removing particles as small as one tenth of a micron is also shown, as well as air intake silencers and combination filter-silencers, breather filters, and other accessories.

33. Pneumatic Cylinders . . . Hannifin Corporation lists their series "R" (leakproof), series "LW" (cup type) and series "LW" (small bore) pneumatic cylinders in their Bulletin 210. Full specifications are given for each type of cylinder, as well as information on accessories, parts, and engineering data. Both the series "R" and series "LW" are available in 3 to 12 inch bores and are available in all standard mounting styles in both plain and cushion models. The "LW" cylinder is available in 1 to 2½ inch bores in both single and double and piston rods and with or without adjustable cushion.

CIRCLE NUMBERS ON THE CARD AND MAIL!

34. 26 Product Problems Solved . . . Bulletin 449 just issued by Gast Manufacturing Corporation gives case histories of 26 product applications in which Gast rotary air motors solved operating and production problems. A number of these problems will be within the range of experience of a great many designers and operating engineers. Three new models—Model 3040-V2, single chamber pump, Model 10X1040-2, a small dual chamber pump, and Model 11X1740-2, a large dual chamber pump are shown, as well as the advantages of the Gast rotary design and specifications of the standard air motors, air compressors, and vacuum pumps in the line.

35. Pump and Valve Data Book . . . A loose-leaf catalog on the complete line of Fulflo centrifugal coolant pumps and hydraulic by-pass piston-type oil relief valves is available from The Fulflo Specialties Company, Inc. Complete data, including dimensional drawings, specifications and parts list are listed for motor driven and for direct driven and belt drive machine tool and grinder types of pumps. The data on the by-pass piston type oil relief hydraulic valves, available in sizes from ¼ to 2 in for pressures to 500 psi, is arranged similarly.

36. Separators, Aftercoolers . . . The separators and aftercoolers offered by The Johnson Corporation are described in bulletin "S" issued by this company. Five types of separators for maximum working pressures of 125, 150, and 250 psi are described, pictured, and specifications given. The Johnson aftercooler is also shown with specifications of the five capacities available.

37. Universal Pneumatic Die Cushion . . . Dayton Rogers Manufacturing Company has issued a four page bulletin on several models of their Universal pneumatic die cushions for all cushion applications. Single unit, tandem and multiple tandem designs are shown, as well as counterbalance cylinders for punch presses and power brakes. The new Dayton Rogers pitman with automatic ram tonnage control is also shown. A wide range of diameters and tonnage capacities is available.

38. Leather Vee Packings . . . Circular issued by C. W. Marsh Company illustrates and describes the line of ThermoVee packings offered by this company. Installation suggestions are given by cross-section drawings and tables give recommended dimensions. Engineering data on how to determine overall packing height is also included.

39. "O" Rings . . . Form No. SL3-LU-449, an 8-page bulletin issued by The Dow Chemical Company, lists a number of applications of saran, an organic thermoplastic, including the use as "O" rings, pipe gaskets and as lined steel pipe and fittings. The excellent chemical resistance of saran makes it advantageous for processes where corrosion is a severe problem. For service where continuous temperatures not greater than 190 F are encountered saran is very satisfactory. Tables of chemical resistance and of physical properties are included. The good abrasion resistance of saran plus chemical resistance has given very satisfactory results as "O" rings for sealing carbon tetrachloride.

CIRCLE NUMBERS ON THE CARD AND MAIL!

40. Air Compressors . . . The Industrial Division, Westinghouse Air Brake Company, has issued 20-page bulletin IDC 9302-3 on their single and two stage "Y" line of compressors and their two sizes of type "G" single stage compressors. Models of the "Y" two stage compressors for operating pressures of 175 and 250 psi in capacities of approximately 6 to 40 cfm, single stage compressors for operating pressure of 80 psi in capacities of 10 to 75 cfm and type "G" single stage compressors for operating pressures of 80, 100 and 150 psi in capacities of approximately 4 and 8 cfm are shown with specifications. Pressure tanks and accessories are also shown. Two pages are given over to a recommended method for selecting an air compressor.

Simplify Pneumatic Design Problems

with this unique electrically-operated

AIR CYLINDER WITH HYDRAULIC CONTROL

MODEL BSM AIR MOTOR

DC-50 HYDRO-CHECK

Permits Positive Control of Piston Speed in Either or both directions and at any point in piston travel.

Provides Absolute smoothness of piston movement — eliminates the natural "bounce" or "springiness" of air.

The Bellows Model BSM Air Motor (a double acting air cylinder) is a complete power unit in itself. Valve, electric valve operating controls, and speed controls are all built-in. The low-voltage built-in solenoid controls operate all day without hum, pounding, or excessive heat. And fast — speeds up to 2200 movements per minute.

When used in the same assembly with the new Bellows Hydro-Check (an adjustable Hydraulic Resistance Unit) you obtain precision control and precision operation of pneumatic systems, easily adjusted to fit any operating requirement.

As a design engineer you'll be interested in knowing more about the Bellows system of pneumatic operation and controls. We'd like to send you two new bulletins showing how "Controlled-Air-Power" operates. No cost. No obligation. Just drop us a note and ask for your copies of Bulletins AV-200 and HC-600. Address The Bellows Co., Dept. AH-949, Akron 9, Ohio.

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AKRON, OHIO

41. Condensed Catalog . . . Ward Leonard Electric Co. has just issued Bulletin 100,000 an 8-page condensed listing of the complete line of electric control devices made for industrial and commercial control applications. Products described and illustrated include: rheostats, resistors, relays, motor starters, speed regulators, contactors, dimmers and control accessories.

42. Hydraulic Duplicators . . . A new four-page bulletin on the one, two and three dimension hydraulic duplicators they make has been issued by Walker Hydraulic Duplicator Co. A number of installation photographs shows the duplicators on a wide range of regular and special machine tools. The operation of the duplicators is described and their advantages in increasing production at lower cost is pointed out.

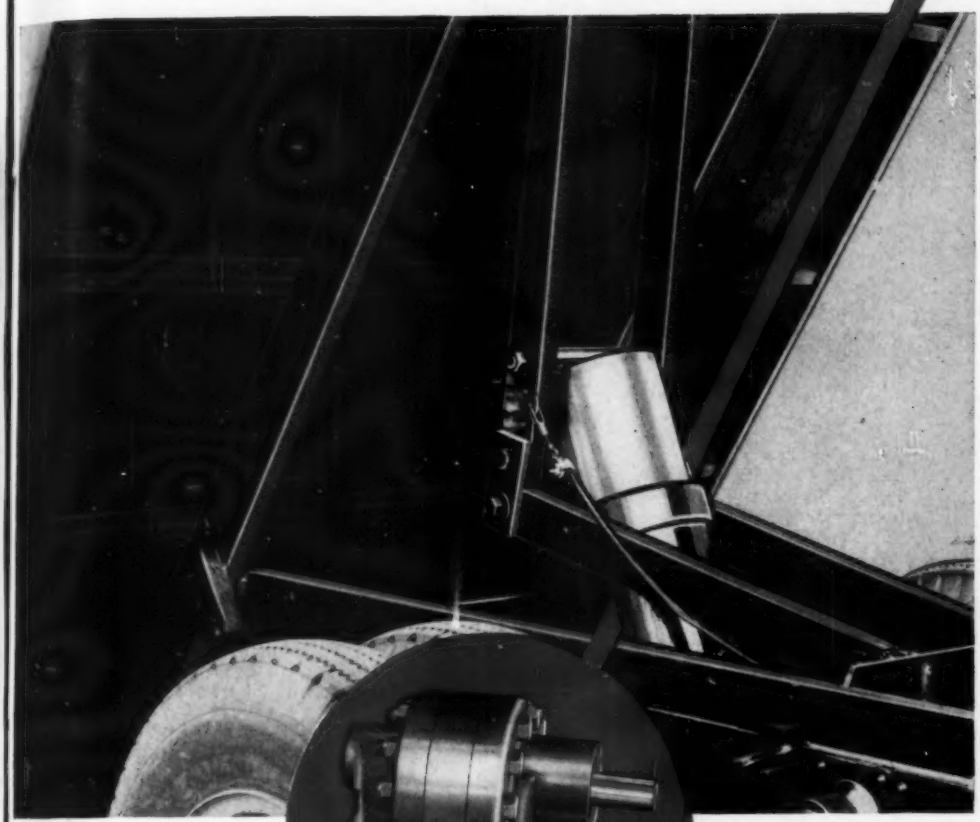
43. Pipe Makers . . . The W. H. Brady Company has issued a four page folder on their new Quik-Label pipe markers. These pipe markers conform to ASA Standard No. A13 as to color and nomenclature for Pipe Identification Systems. The folder has a stock list of standard pipe markers available.

44. Quick Guide to Relays and Timers . . . Struthers-Dunn Inc. A quick guide to Struthers-Dunn relays and timers issued as Catalogue G is a condensed reference manual to the major types of industrial relays and timers offered by this company. The catalogue also includes midget, sequence and special purpose relays. Each type of relay is illustrated and specifications are given. There are some brief but practical information on the selection of relays. Important application data is also included.

45. Precision Parts . . . A new 20-page catalog issued by Kohler Company covers their complete line of precision check valves for aircraft, industrial and automotive applications. flared tube, pipe thread and hose nipple fittings. All high pressure valves and tube and fittings are made to AN specifications. On-off, swing check, angle needle and two-way plug valves are also shown.

46. Air Motor Power Jacks . . . A new bulletin covering the line of industrial air motor power jacks they make in capacities from 20 to 100 tons has just been issued by The Duff-Norton Manufacturing Company. Design and construction features, job applications and specifications are given. All jacks operate from normal air pressure of 80 to 90 psi; their speed of operation and economy of man power make them particularly advantageous for pushing heavy duty pipe, sinking piles, straightening operations as well as lifting and lowering of heavy loads.

Cemco chooses H-P-M Gear Pumps



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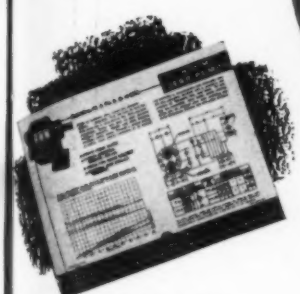

Write for Data Sheet 491 giving complete information about H-P-M Gear Pumps, including charts giving volumetric efficiency and horsepower required for various working pressures.

A hoist is no better than its pump!

Overloading—a common practice among dump truck operators, causes serious "headaches" to hoist and dump body manufacturers. To eliminate hoist failures . . . loss of good will . . . high replacement costs . . . and to maintain proper oil pressure throughout the complete dumping cycles, Cemco Industries, Inc. use and praise H-P-M oil hydraulic Gear Pumps.

If your products call for PUSH . . . PULL . . . or LIFT, you can do the job better with H-P-M Hydraulics . . . and you can do it economically. An H-P-M engineer will call to discuss modern Hydraulic Power with you. Write today.

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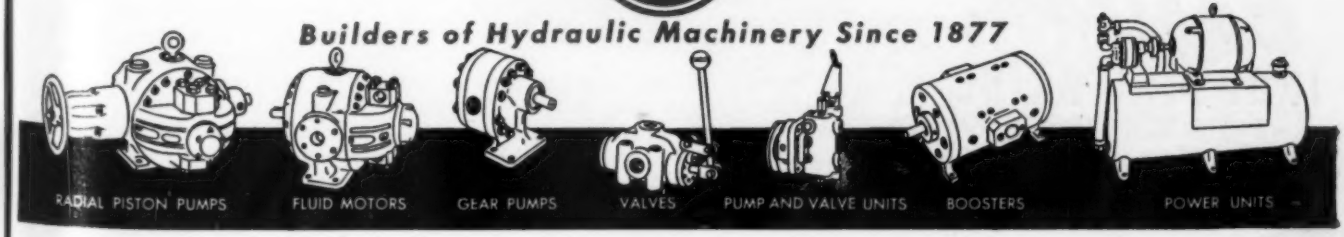

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IN THESE HYDRAULIC PUMPS and FLUID MOTORS

There's plenty of power in Eastern fluid motors and hydraulic pumps. They're tough and compact—ideal where space is at a premium. They're dependable, too. Long life under rugged operating conditions is built-in. An Eastern hydraulic pump or fluid motor in your design is good engineering.

SERIES 100

.1 to 5 GPM—Drive speeds up to 3450 RPM. Working pressures up to 1000 PSI. Average volumetric efficiency: 90%. Average model weight: 1.65 lbs.

Lightweight construction is obtained through use of aluminum housings and nitralloy gears and shafts. Each unit is factory pre-tested for precision and operating efficiency.

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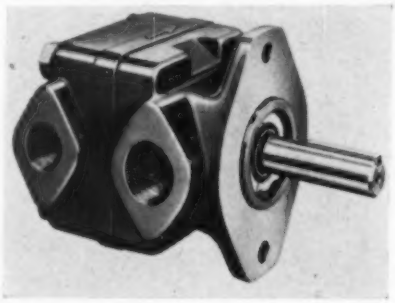
NEW HAVEN 6, CONNECTICUT

(Continued from page 24)

pletely new and improved line of Lindberg-Fisher single stage, centrifugal blowers. With "full 360 degree positioning" of the air outlet, the blowers are easy to install and eliminate pipe cutting, welding and extra piping. Belt-driven blowers have been designed to save approximately half the floor space normally required by other conventional type belt-driven blowers. *9.*

Balanced Vane Pump

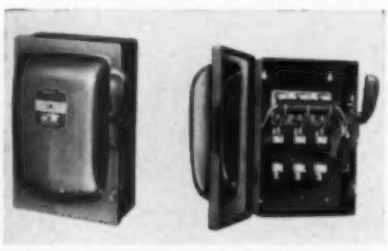
A new balanced vane pump, Series V-200, designed expressly for hydraulic systems on agricultural, automotive, construction and materials handling equipment, is announced by Vickers Incorporated. Featuring longer life at



maximum efficiency far in excess of fixed clearance pumps, the V-200 is designed to automatically maintain correct radial and axial clearances at all times. The pump automatically adjusts its clearances to oil viscosity variations resulting from temperature change and compensates perfectly for normal wear. The "vane" principle provides for no-load starting; "hydraulic balance" eliminates bearing loads resulting from pressure. Greater mounting adaptability is provided. The V-200 pump is made in four capacities—2 to 11 gpm—for operating pressures up to 1000 psi. *10.*

Industrial Safety Switches

The Square D Company, pioneer manufacturer of safety switches, announces three completely new lines—Type A, Heavy Duty Industrial Service, Type C, Standard Duty Industrial Service and Type D, General Purpose Service. A full cover interlock feature on Type A switches has an exclusive attachment that locks the switch "on" or "off". Switches are compact, yet



easily wired. Line terminals are dead front, protected by the hinged arc chamber cover. A magnetic plate in the arc chamber cover adds to the high rupture capacity; jaws and fuse clips are steel reinforced to exert positive pressure. Types C and D are similar in appearance and dimensions to Type A, with design and construction details differing to meet service demands. Thirty and 60 ampere sizes are now available with larger sizes to follow. *11.*

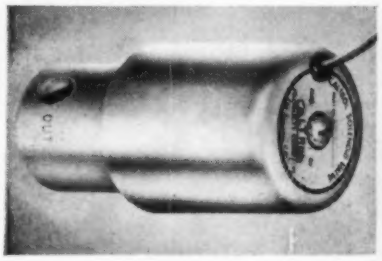
CIRCLE NUMBERS ON THE CARD AND MAIL!

Press Control Unit

A newly developed model No. 140-X "Robotron" control unit, designed to perform automatic bumping (breathing) operations on hydraulic presses is announced by Emmett Machine & Manufacturing, Inc. The unit is quipped with three built-in time arrangements and is wired for use with limit switches to regulate the amount of press opening, to close the press at a predetermined time and to hold the press closed until the next bump. The unit can be set to give from one to 40 bumps per cycle as well as to control the overall cure time. Model No. 140-X is recommended for processes where changes of cycles or molds are common and where complex bumping combinations are necessary or where remote control of any hydraulically operated press is desirable. *12.*

Solenoid Shutoff Valves

Caltron Products Co. announces a new design of the "Caltron" Solenoid Shut-Off Valve. Built around a new valve seat arrangement, the new valve



is low in initial cost and economical in operation. The direct flow design with very small pressure drop, permits operation from zero to 600 psi for both oil and air applications. Valve body materials in aluminum, brass or stainless steel meets a wide range of specific requirements. *13.*

Pressure Plug

A new socket pressure plug that seals pressure-tight without the use of sealing compounds has been announced by Standard Pressed Steel Co. Featuring the "Dryseal" pipe thread originally developed for use with SO_2, ammonia and other refrigerants, the new Unbrako Dryseal-Thread pressure plug offers a solution to leakage problems in high-pressure equipment of all kinds. The design of the "dryseal" thread provides actual crushing or sealing at both major and minor diameters, effectively preventing spiral leakage. A full range of sizes from 1/16 to 2 in, NPTF, is available. *14.*

APPLIED HYDRAULICS DIGEST

Abstracts, summaries and listings of articles on hydraulic and associated applications in industry; reports on prepared papers, talk and discussions pertinent to the hydraulics field.

Components and Applications of Industrial Hydraulic Systems

A. G. Winchester, *The Tool Engineer,* v 23, July, 1948, pp 28-31.

This article is based on a talk given by the author before the Baltimore Chapter of the American Society of Tool Engineers and is an orientation survey of the components for industrial hydraulic systems and the applications of hydraulic systems with particular attention given to the characteristics and uses of hydraulic cylinders, valves, pumps, motors and auxiliary equipment. The identification of components into types based on their functions is rather generally covered

(Continued on page 30)

Continental *plastics* USES

HONAN-CRANE for HYDRAULIC OILS

Continental Plastics Corporation, Chicago, uses Honan-Crane oil purification equipment on each Reed-Prentice injection molding press.

The continuous removal of all contamination (dirt, acids, varnish and sludge) protects the pumps, valve parts and other precision parts of hydraulic system. Excessive press maintenance and down time is eliminated.

For full information on low cost purification and maintenance of hydraulic oils, write to Honan-Crane Corporation, 102 Wabash Avenue, Lebanon, Ind., subsidiary of Houdaille-Hershey Corporation.

Even with aircraft hydraulic fluids—

DENISON HydrOILic PUMPS OFFER HIGHER EFFICIENCY FOR A WIDER RANGE OF JOBS

At last you can have a variable volume pump that will maintain high volumetric efficiency on oils of widely ranging viscosities—from light aircraft oil to heavy industrial types.

That's just one advantage of the advanced and highly simplified design of Denison HydrOILic High-Pressure Pumps. Skillful engineering packs extra precision into these compact, rugged units—*and brings their cost far below other pumps of equal rating.* You get long-wearing, maintenance-free operation on all of today's wide range of pump applications.

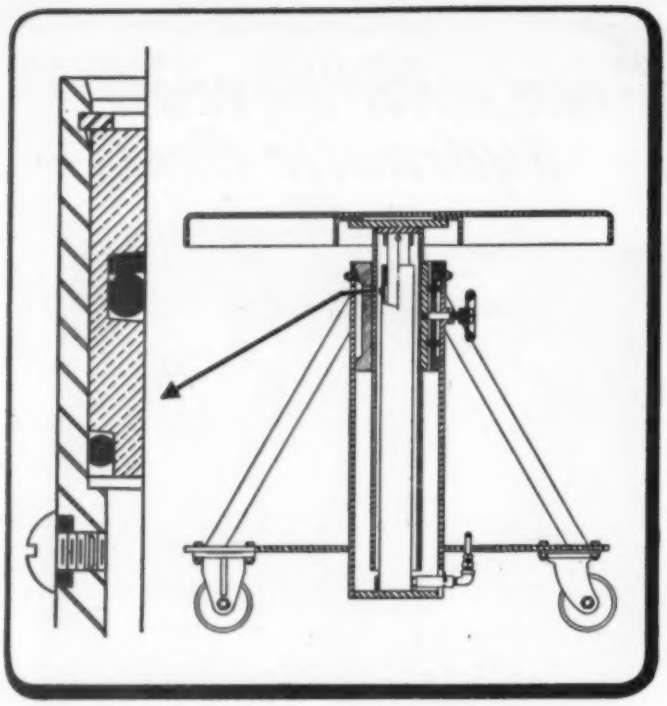
QUIET, TOO! You also get rid of the objectionable noise of high pressure oil-hydraulic systems when you use Denison pumps. They are remarkably quiet, at all stages of operation.

CONSTANT OR VARIABLE VOLUME TYPES. Denison pumps are built in both constant and variable-volume types, for face, foot or flange mounting, in models developing up to 5000 psi, with volume capacities from 6 to 35 gpm. A choice of hand-wheel, stem, and pressure-compensating volume controls is available. Small size and efficient design make any Denison pump easy to adapt to your individual needs. Write today for bulletin P-2!

If interested in a similar pump for portable test purposes, write for details on the new, unitized Decopak.

DENISON EQUIPMENT for APPLIED HydrOILics

The DENISON Engineering Co.
1166 Dublin Road • Columbus 16, Ohio



25% Saving
with
Linear "O" Rings*

Another LINEAR achievement! "O" Rings used in this Lyon-Raymond Portable Hydraulic Elevating Table simplified design and effected savings of nearly 25%. After a test of 50,000 operating cycles with pressures varying from 900 p.s.i. to 2,000 p.s.i., the "O" Rings showed little wear and were effectively holding a fluid-tight seal.

Whether you require a seal for a hydraulic design or for a special service, LINEAR precision moulded packings will serve you well.

In addition to a long list of natural or synthetic rubber compounds adaptable to a wide range of temperatures, gases and liquids, LINEAR is successfully moulding "O","V", "U" or other shapes of Kel-F, Teflon and Silicone for special applications. These special materials are suitable for seals for a wide temperature range from minus 320° F. to plus 400° F. against concentrated sulfuric, hydrofluoric, hydrochloric and other vigorous oxidizing materials.

For your individual packing design or application, CALL LINEAR.

*The use of "O" Rings in certain packing structures is covered by Christensen Pat. No. 2,180,792 under which we have paid the royalty for the installation of our rings in these structures so that the royalty is included in the purchase price of the "O" Ring.

"PERFECTLY ENGINEERED PACKINGS"
LINEAR
LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.

DIGEST

but the characteristics of double-acting cylinders, hydraulic valves, accumulators, pumps and fluid motors are digested in excellent form. A group of five typical industrial applications of hydraulic systems is described and illustrated by circuit diagrams.

Hydraulic Fluids

Anonymous, *Aviation Week,* v 51, July 18, 1949, p 29.

A brief survey of the tests conducted by the Civil Aeronautics Administration with TWA, Boeing and United Air Lines cooperating. TWA ran tests with Hydrolube U-4, developed by the Navy, in the cabin supercharger system of a Constellation. Approximately 825 hours of operation were reported with excessive wear on pump and motor parts due to lack of lubricity at high operating temperatures and erosion due to cavitation caused by the susceptibility of the fluid to aeration. CAA ran tests of Hydrolube U-4 in both Douglas DC-3 and DC-4; the latter tests were discontinued because of excessive corrosion in magnesium fittings and valves. The DC-3 tests show the same tendencies. Boeing ran the same fluid in a mockup system of the 377 Stratoliner for 200 hours at various temperatures. At this point the system broke down due to accumulated sludge. United Air Lines tested Skydrol (Monsanto Chemical Co.) in the cabin supercharger system of the Douglas DC-6 and after 600 hours of flght time the system is still operating satisfactorily. Spilled fluid has removed paint and affected electrical wiring adversely. TWA has tested Stan-Cal Type A, a new fluid, in a supercharger run-in test stand and has accululated about 600 hours. Using special fluid seals the test installation has held up to date. This fluid, like the U-4, would require complete replacement of hydraulic seals.

Service tests so far indicate, in general, that the fluids are either non-flammable or suitable hydraulic fluids but not both and that non-flammable hydraulic fluids, while exhibiting desirable non-flammable characteristics, create corrosion, lubricity, cavitation and deterioration hazards that perhaps only an entirely new chemical approach to the problem can solve.

Air-Operated Devices for Lathe Application

Harry L. Stewart, *Product Engineering,* v 20, July, 1949, pp 128-129.

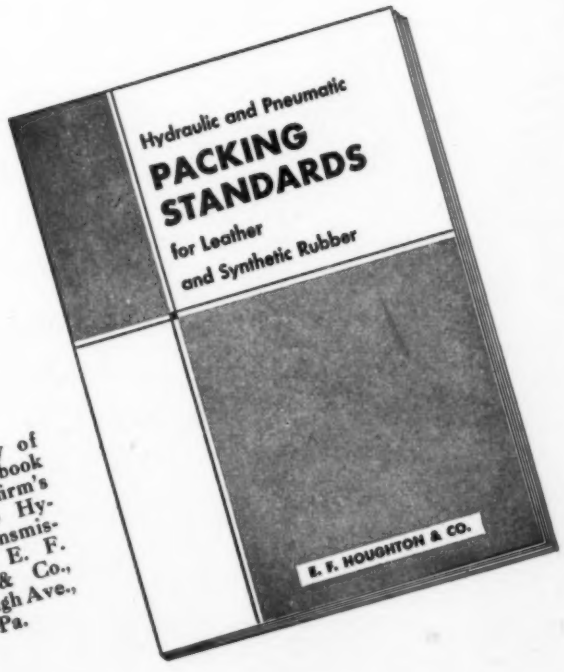
A group of six applications are briefly described and diagrammed: a single rotating cylinder-piston assembly for controlling the clamping pressure of step-cut false jaws in a universal power chuck; a compensating air chuck in which the tail stock center is utilized; a non-rotating cylinder-piston advances the tailstock center, positioning the work in chuck operated by rotating cylinder; a rotating cylinder assembly that locks bar stock fed through a hollow spindle in a collet-type

(Continued on page 32)

Houghton...

the packing supplier that prepared the first authentic handbooks on leather and synthetic rubber packings, is now

first to set up "specs" for packing standards!



For free copy of this new handbook write on your firm's letterhead to Hydraulic & Transmission Dept., E. F. Houghton & Co., 303 W. Lehigh Ave., Phila. 33, Pa.

Industry expressed a desire for packing standardization, as between types of packings, dash numbers, uniform clearances and tolerances. Number of sizes should be reduced also, it was stated at the Joint Industry Conference meetings in Detroit.

Houghton was ready and willing to cooperate. Even better, our engineers showed them how it could be done, and then led the way for other packing suppliers by setting up specifications which will be generally followed.

We then prepared the handbook shown here, as a supplement to our authoritative reference books on leather and synthetic rubber packings. This book should be in the hands of every designer of hydraulic equipment, and packing maintenance man.

Here is another indication of Houghton's leadership in hydraulic and pneumatic packings. The engineering service on individual installations, the high quality and workmanship built into the packings themselves, and the ability to plan and prepare such cooperative projects for the aid of industry — all these are reasons why you should consult Houghton when you need packings.

E. F. HOUGHTON & CO.
PHILADELPHIA
CHICAGO • SAN FRANCISCO • DETROIT
Vim Leather & Vix-Syn Synthetic Rubber Packings

"Smooths the way" for AIR ... or OIL

In all of Monarch Machine Tool's lathes with "Air Gage Tracer", Resistoflex assemblies are used to assure smooth, split-second hydraulic gaging and control. For they proved to be the only lines to live up to required performance.

Once again Resistoflex hose ends a line problem.

In Monarch Machine Tool's method of duplicating work automatically, gaging of a master template is done through the medium of air. Because of the sensitivity of the "Air Gage Tracer," unrestricted, precise air flow is *imperative*. In addition, the line must withstand continuous flexing. Monarch finds the answer to both in Resistoflex hose. Not only is it immune to flexing and vibration, but, with its glass-smooth compar tube, it allows full air flow without any turbulence!

Of course, if you use *oil* as a medium, you're also concerned about hose-deterioration and clogging. But you needn't ever worry on that score either with Resistoflex lines. Impervious to hydraulic fluids, these non-sloughing lines assure *clean, smoothly working* circuits at all times.

Do you have a line problem? Discover how you can transmit oils or gases through fatigue-proof Resistoflex lines and reduce servicing. Write us about it.

RESISTOFLEX

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Belleville 9, New Jersey

SYNTHETIC FLEXIBLE PRODUCTS AND PARTS FOR INDUSTRY

DIGEST

(Continued from page 30)

chuck setup; hand operated air valves to control movement of tailstock and locking jaws of mandrel in a mandrel-type chuck; and a double jaw mandrel chuck application utilizing a rotating air cylinder and foot-operated control valve.

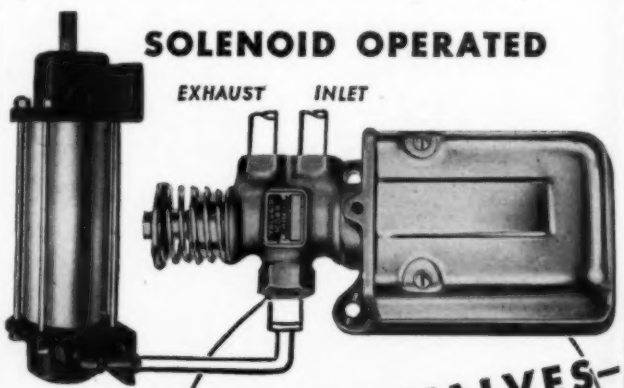
Industrial Electronics Has Grown Up

Philip J. Costa, from paper *"Industrial Electronics Has Grown Up"*, presented at the SAE Central Illinois Section, Peoria, Feb. 21, 1949.

The author points out that the status of electronic equipment as "boxes of black magic" has been outmoded and that design and methods of production have converted electronic instruments from hay-wire bread-boards into precision devices that have definite and accepted places in the industrial picture. He illustrates his point by showing in detail with pictures and diagrams the installation of an automatic electronic timer to measure the friction coefficient of clutch plate material; the installation consisting of a magnetic pickup, a microswitch and an amplifier incorporating an electric timing clock.

(Continued on page 36)

SOLENOID OPERATED



AIR CONTROL VALVES—"VALVAIRS"

- NON-CORROSIVE
- NO METAL SEATS
- FULL PIPE AREA USED

2-WAY
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4-WAY
60 numbers to choose from

Ask for Folder "S-H"

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AFFILIATE: SINCLAIR-COLLINS VALVE CO.

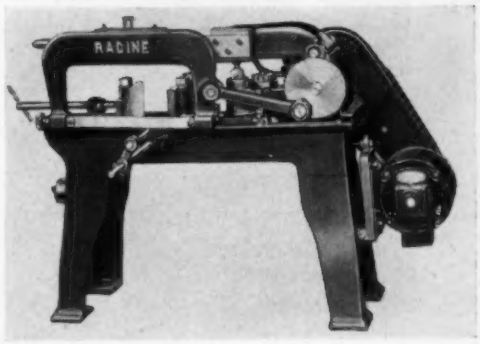
Rely upon Valvair

RACINE TOOL & MACHINE COMPANY

The Racine Tool & Machine Company, manufacturers of high speed metal cutting machines and of variable volume radial vane hydraulic pumps, a pressure booster and hydraulic valves, utilize their own hydraulic components in their full line of metal cutting machines.

METAL CUTTING SAWS

General Purpose "Dry Cut" Utility Saws



General: This is the smallest hydraulic metal cutting machine made by Racine. This machine, No. D-3-B, is an excellent producer for small shops and is widely used for its fast, accurate work. In a 6 in x 6 in capacity, the machine is designed for all around metal cutting from thin walled tubing to tough alloy steel bars.

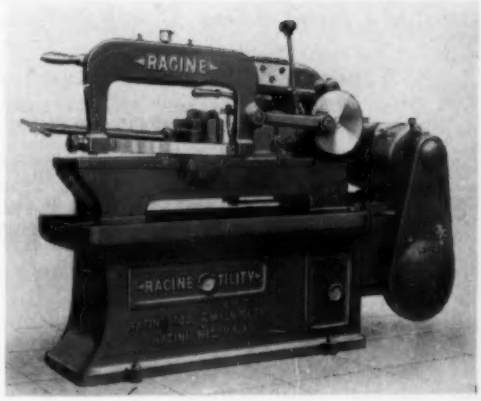
Specifications: Catalog No. 70-C.

Hydraulic Circuits: The simple, compact Racine self-contained hydraulic assembly provides accurate control of feed and pressure. Pressure is controlled by a single graduated valve; rate of feed is controlled by a small throttling valve.

Attachments Available: Catalog No. 70-C.

Operation, Service and Parts Manual: Submit serial number of machine.

General Purpose "Wet Cut" Utility Saws



General: With the same capacity as the "Dry Cut" Utility No. D-3-B, this saw, No. W-3-B, is available in either the two speed V-belt drive as on the Dry-Cut model or with a three speed sliding gear transmission with chain drive. The three speed drive is recommended for tough alloys, tool steels and high speed steels.

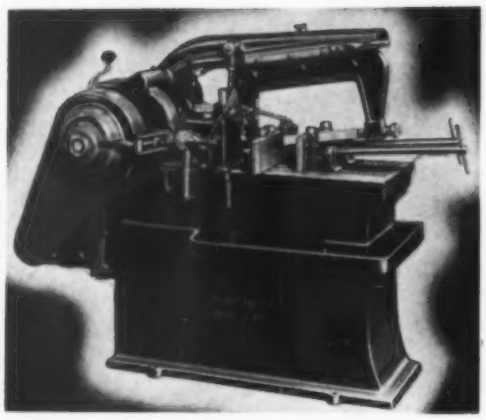
Specifications: Catalog No. 70-C.

Hydraulic Circuits: Same as the "Dry Cut" model. The only difference is that the "Wet Cut" models run at high speeds and have a coolant tank and pump.

Attachments Available: Catalog No. 70-C.

Operation, Service and Parts Manual: Submit serial number of machine.

METAL CUTTING MACHINE



Oil Cut Hi-Speed Metal Cutting Machines

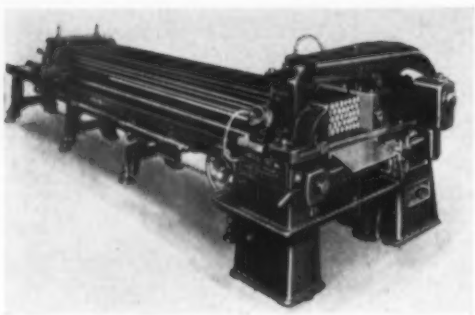
General: These machines have proven their superiority for general cutting of bars, tubing, structural shapes for tool rooms, maintenance departments and modern production shops. A single lever controls feed, clutch, rapid traverse and neutral operating positions. The 6 in x 6 in capacity machine has three speeds—70, 100 and 140 strokes per minute.

Specifications: Catalog No. 60-A.

Hydraulic Circuits: A single sub-assembly Racine hydraulic unit is self lubricated and easily removable for maintenance. Feed is self-compensating, automatically regulating itself to type, size and shape of work. Feed and pressure are hydraulically controlled.

Attachment Available: Catalog No. 60-A.

Operation, Service and Parts Manual: Submit serial number of machine.



30 Series Hydraulic Automatic Bar Feed Machines

General: Automatic stock feed machines for use with Racine hydraulic metal cutting saws do a multiple metal cutting job as automatic as the modern screw machine. The machines are available with "Oil Cut" Model No. 6 and heavy duty models Nos. 30, 31 and 33 in 10 in x 10 in, 12 in x 12 in and 13 in x 16 in capacities.

Specifications: Catalog No. 90-A.

Hydraulic Circuits: Hydraulic control of cutting feeds and pressures; direct gauging of lengths to be cut progressive feed-up and chucking of stock, clamping and releasing of stock vises.

Attachments Available: Automatic hydraulic vise, swivel base—Catalog No. 90-A.

Operation, Service and Parts Manual: Submit serial number of machine.

Heavy Duty Metal Cutting Machines

General: Heavy duty production metal cutting machines in capacities of 10 in x 10 in, 12 in x 12 in, 12 in x 16 in, 14 in x 20 in and 20 in x 20 in, are fully hydraulic with hydraulic feed and control (single lever), automatic knockout and clutch control.

Specifications: Catalog No. 80-D.

Hydraulic Circuits: Standard Racine hydraulic system (see General above).

Attachments Available: Catalog No. 80-D.

Operation, Service and Parts Manual: Submit serial number of machine.

GENERAL INFORMATION

Catalogs listed as well as bulletins on pumps, valves and boosters are available from Racine Tool & Machine Company, 1774 State St., Racine, Wisc. Please send requests on company letterhead.

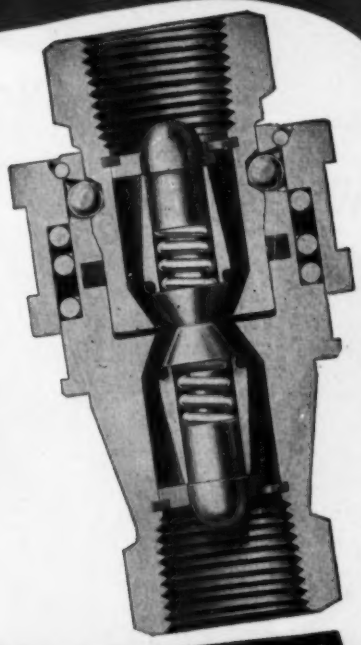
All Racine machines, attachments and accessories and hydraulic components are protected by issued and pending United States patents.

SAVE THIS VALUABLE REFERENCE MATERIAL: BUILD UP A PERMANENT FILE

"NEW" FOOLPROOF

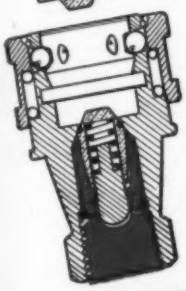
HANSEN

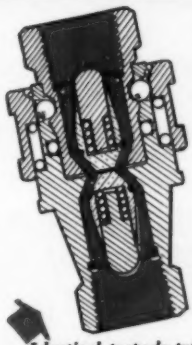
HIGH PRESSURE 2 WAY SHUT-OFF COUPLINGS



SEALS BOTH ENDS OF LINE AUTOMATICALLY INSTANTANEOUSLY

Red section shows how torpedo type valves contact valve seats in both socket and plug to provide instant seal of fluid in both ends of line.





Identical torpedo type valves in socket and plug are mounted to permit free flow of gas or liquid through connected coupling.

Hydraulic and pneumatic lines can be quickly, easily, and safely connected or disconnected with the Hansen High Pressure Two-Way Shut-Off Coupling—with both ends of line positively sealed when coupling is disconnected.

To connect, you merely pull back sleeve and push plug into socket. Identical torpedo type valves in plug and socket are mounted to permit free flow of gas or liquid when coupling is connected.

To disconnect, just pull back sleeve—coupling immediately disconnects, valves automatically and instantly seal both ends of line.

Plugs and sockets furnished with ½" Female Pipe Thread connections.

CAN BE AUTOMATICALLY DISCONNECTED TO PROTECT FLUID LINES

For applications where fluid lines would otherwise be damaged by sudden strain, the Hansen coupling can be mounted in a stationary bracket to pull back sleeve and disconnect coupling instantly and automatically—leaving fluid lines free, positively sealed, and—undamaged.

Write for Industrial Catalog No. 47

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QUICK CONNECTIVE FLUID LINE COUPLINGS . . .

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What do we mean by "repetitive, extra heavy duty"?

We mean that you can cycle this valve at rates up to 400 closings per minute for millions of operations without need for repairs. We mean it can handle pressures up to 250 psi on air and non-corrosive gases . . . up to 175 psi on water, steam, refrigerants . . . on light oils up to 150 psi. We mean that the solenoid coils are Class A insulated for temperatures up to 212° F and high temperature insulated for temperatures up to 450° F. We mean that valve discs close in direction of flow and are of the ASCO Self-aligning form to insure tight-seating under all conditions. One pipe size only—3/8 inch; three port areas—1/8, 5/32 and 1/4 inch.

Yes, our Bulletin 8265 Shut-off Solenoid Valve will provide a lot of repetitive service. It's efficient and durable. In asking for Valve Section 6-V, which gives full details of this valve, tell us about your problem.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.

385-H Lakeside Avenue • Orange, New Jersey

DIGEST

(Continued from page 32)

Ultrasonic Testing of Aircraft Components

William C. Hitt, *The Iron Age,* v 163, June 23, 1949, pp 66-70.

A description of the operation of the Sonizon, an ultrasonic instrument made by Magnaflux Corp. for measuring thickness when only one side of the part or material is accessible and to locate subsurface defects such as porosity, laminations, pockets, forging cracks, lack of bond and loss of material from wear or corrosion. Blind ID dimensions of tubular sections, such as landing gear truss, can be checked for loss of material by corrosion; checking taper dimensions, dimensional control of spun parts, exhaust tubes during routine overhaul, fuselage skin thickness are some of the other practical tests now being made.

Torque Converter Transmission

J. G. Vincent and **Forest McFarland,** *Machine Design,* v 21, July, 1949, pp 117-120, 168.

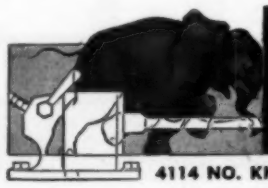
The vice president of engineering and chief engineer of research of Packard Motor Car Co. describe the Ultramatic automatic hydraulic transmission, a two stage turbine torque converter with planetary gearing.

Air Operated

ROTARY WORK FEEDER

Deftly holds and delivers small parts to drill, tap, swage, stake, etc. Stations accurate to .002". Guaranteed against over-travel or "skipping". Indexes as slow or fast as you like, up to 10,000 per hour. Compact and sturdy, easy to tool and hook up.

Standard dial plate 10"; available in 12". For a new job, simply tool up a new dial. Readily combines with "MEAD-MATIC" Timer, Air Hammer, Air Press, Drill presses, etc.—to make almost completely automatic machine—operator merely loads. Write for full details.



MEAD
SPECIALTIES COMPANY

4114 NO. KNOX AVE., DEPT. AH-99 CHICAGO 41, ILL.

Two clutches and two brakes are arranged to obtain a high range, straight-through drive and a low range, geared drive. Converter or direct mechanical drive operates in either range. Starting is through the torque converter in either range, with automatic shift into direct mechanical drive governed by car speed and throttle position. The torque converter assembly consists of the two stage turbine and a reactor member. The pump, which also serves as the assembly housing, is at the rear. An overrunning clutch locks the reactor member during torque multiplication, then releases it when the coupling point is reached, after which the converter acts as a coupling until the direct drive engages. The high range clutch is a conventional form with cork composition type of plates, vent holes in the piston and an air bleed in the supporting member to avoid engagement in reverse. Pistons for actuating the low range and reverse brakes are of a fast-acting type; the low range brake is operated by modulated pressure, the reverse at 170 psi.

Gearing is of the helical type of 20-degree pressure angle, 20-degree helix angle, 14.9 normal pitch with addendum height modified to balance the action, and with involute contact ratio of 1.4 and helical contact ratio of 1.8.

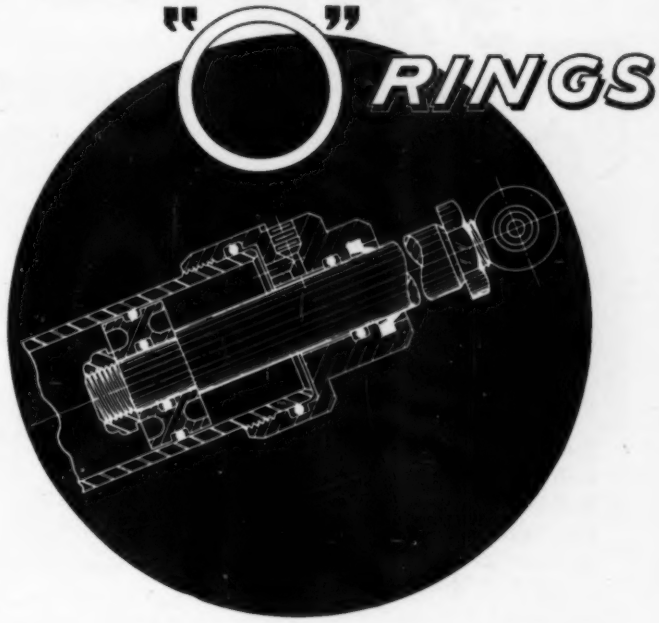
Illustrations show a cross section of the entire transmission, turbines and reactor member, arrangement of planetary gearing, performance curves and a schematic diagram showing the method of applying both clutches and brakes hydraulically. Various positions of the selector lever locate the control valve in a position to

Why waste labor on "muscle jobs" of pushing, pulling, lifting or control operations? T-J Cylinders will do it *automatically . . . with accuracy . . .* and *cut costs!*

For 100 lb. or 50,000 lb., there's a T-J Air or Hydraulic Cylinder that's *right* for your requirements. Many standard sizes and styles . . . both cushioned and non-cushioned types. Precision-built . . . backed by 31 years of know-how . . . dependable. Write for catalogs. The Tomkins-Johnson Co., Jackson, Michigan.

TOMKINS-JOHNSON
RIVETORS · AIR AND HYDRAULIC CYLINDERS · CUTTERS · CLINCHORS

LINEAR "O" RINGS



CUT PRODUCTION COSTS . . . SIMPLIFY DESIGN

This compact hydraulic cylinder is only one of the outstanding examples of how LINEAR "O" rings have reduced production costs through simplification of design and installation methods.

Thousands of installations *in every field of industry* have been effectively redesigned to use LINEAR "O" rings for sealing over a wide range of pressures and temperatures. Special assembly tools are unnecessary and *no critical gland adjustments need be made!* And LINEAR "O" rings not only seal pressures in both directions but have low running friction on moving parts.

Compounded of natural or synthetic rubber for nearly every condition, LINEAR "O" rings are also available moulded of Kel-F or Silicone to resist the actions of vigorous oxidizing materials over a wide temperature range.

For your individual packing design or application, CALL LINEAR. At LINEAR rigid supervision guarantees results.

The use of "O" Rings in certain packing structures is covered by Christensen Pat. No. 2,180,792 under which we have paid the royalty for the installation of our rings in these structures so that the royalty is included in the purchase price of the "O" Ring.

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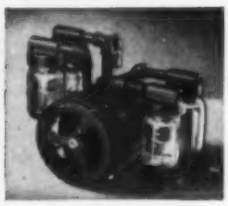

Dual Chamber Model 10 x 1040 (Small size)

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These 3 new Air Pumps offer: *Both* strong "blow" for separating—and large capacity vacuum for "pick-up" of materials on automatic feeding of paper, cardboard, thin metal, acetate, etc. Gast Rotary Design produces large volume per h.p. at lower speeds. V-belt drives make installation and speed control easy. Get details—remember, "Air may be *your* Answer!"

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cause oil flow to the proper actuating unit. In neutral and park, oil is applied to the top of the low range and reverse pistons to provide full release; in high range oil actuates the high range clutch by modulating oil pressure proportional to throttle opening. Shift from low to high range is accomplished by the timing valve, the lag accomplished by metering of displaced oil, assuring the positive disengagement of the low range brake. Shift from high to low range is similarly delayed to prevent premature engagement of the brake. The rear pump is used for starting; the front pump idles in direct drive.

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Index to Technical Data Digest

Central Air Documents Office (CADO-T) Wright-Patterson Air Force Base, Dayton, Ohio, has issued an Index to the Technical Data Digest to cover issues from 1 January 1949, through 15 June 1949. Abstracts are arranged in accordance with the Standard Aeronautical Indexing System (SAIS). It is understood that the Index will be published semi-annually hereafter.

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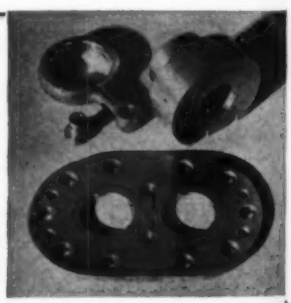

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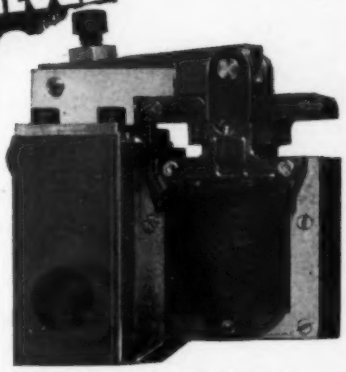

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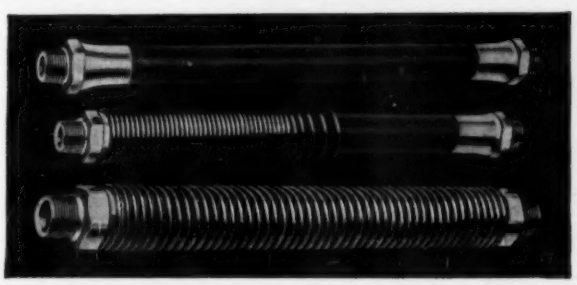

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POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

J. T. Sudduth, who maintains an office at 3017 Sixth Ave., South, Birmingham, Ala., as sales representatives in the South for its complete line of pneumatic products.

Adel Precision Products Corporation has appointed Fred T. Miller as vice president in charge of engineering and sales at the Burbank division. Miller was formerly general sales manager.

C. A. Norgren Co. has appointed Pesco Products Division of Borg-Warner Corp., through its president, R. J. Minshall, announces the appointment of G. V. Patrick to succeed D. A. Sutherland as eastern sales manager for industrial products and the appointment of Frank R. Canney as sales engineer in charge of Pesco's sales activities with the airline companies. Mr. Patrick was formerly executive vice president of the Cleveland Automatic Machine Co. Mr. Canney was with the Boeing Airplane Company.

Denison Engineering Company announces the appointment of Henry Walke Co., 1310 S. Tryon St., Charlotte, N. C., as sales representatives for the Multipress line of oil hydraulic presses and accessories in North and South Carolina.

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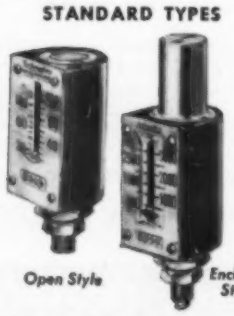

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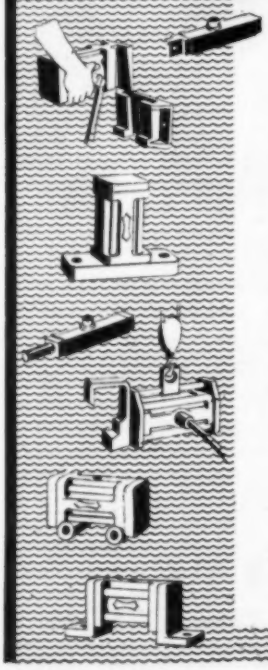

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